GEORGIA INSTITUTE OF TECHNOLOGY — OFFICE OF CONTRACT ADMINISTRATION

PROJECT ADMINISTRATION DATA SHEET

[X] ORIGINAL [ ] REVISION NO. _____

Project No. E-21-675 R6029-0A0 GTRC/~~GIT~~ DATE 9 / 26 / 85

Project Director: Dr. H.B. Puttgen & Dr. John Dorsey School/~~Lab~~ EE

Sponsor: Thomson-CSF, Division Simulateurs 3 Avenue Albert Einstein
78192 Trappes BP116, France

Type Agreement: Research Agreement Dated 9/13/85

Award Period: From 9/13/85 To 9/12/86 (Performance) 9/12/86 (Reports)

Sponsor Amount:	This Change	Total to Date
Estimated:	$	$ 28,719.00
Funded:	$ 28,719.00	$ 28,719.00

Cost Sharing Amount: $ _____ Cost Sharing No: _____

Title: Dispatcher Training Simulator Model Evaluation

ADMINISTRATIVE DATA

OCA Contact R. Dennis Farmer X4820

1) Sponsor Technical Contact:

2) Sponsor Admin/Contractual Matters:

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Contract Administrator
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Defense Priority Rating: _____ Military Security Classification: _____

(or) Company/Industrial Proprietary: _____

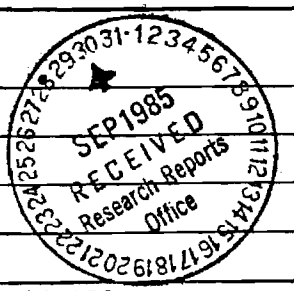
RESTRICTIONS

See Attached _____ Supplemental Information Sheet for Additional Requirements.

Travel: Foreign travel must have prior approval – Contact OCA in each case. Domestic travel requires sponsor approval where total will exceed greater of $500 or 125% of approved proposal budget category.

Equipment: Title vests with NONE PROPOSED OR ANTICIPATED.

COMMENTS:



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GEORGIA INSTITUTE OF TECHNOLOGY OFFICE OF CONTRACT ADMINISTRATION

SPONSORED PROJECT TERMINATION/CLOSEOUT SHEET

Date 11/26/86

Project No. E-21-675 School/~~GaTX~~ EE

Includes Subproject No.(s) N/A

Project Director(s) H. B. Puttgen & Dr. John Dorsey GTRC /~~GXXX~~

Sponsor Thomson-CSF, Division Simulateurs

Title Dispatcher Training Simulator Model Evaluation

Effective Completion Date: 9/12/86 (Performance) _____ (Reports)

Grant/Contract Closeout Actions Remaining:

Please send copy of the required final for OCA file if already submitted.

- [ ] None
- [x] Final Invoice or Final Fiscal Report
- [ ] Closing Documents
- [ ] Final Report of Inventions
- [ ] Govt. Property Inventory & Related Certificate
- [ ] Classified Material Certificate
- [ ] Other _____

Continues Project No. _____ Continued by Project No. _____

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FORM OCA 69.285

GEORGIA INSTITUTE OF TECHNOLOGY
SCHOOL OF ELECTRICAL ENGINEERING
ATLANTA, GEORGIA 30332

TELEPHONE: (404) 894-

June 19, 1986

Mr. J. Lesage
Thomson CSF - DSI
Division Simulateurs
3 Av Albert Einstein
BP 116
78192 TRAPPES CEDEX
FRANCE

Dear Mr. Lesage:

Please find enclosed a brief summary of the training activities related to Mr. Selosse's stay at Georgia Tech.

Sincerely,

Hans B. Püttgen, Ph.D.
Associate Professor of EE

HBP/pk
Enclosure: Report

REPORT

EDUCATIONAL SEMINARS FOR Mr. MICHEL SELOSSE

from THOMSON-CSF, DIVISION SIMULATEURS

at the School of Electrical Engineering
Georgia Institute of Technology
Atlanta, GA 30332

May 5, 1986 through June 4, 1986

As per contractual agreements between Thomson-CSF, Division Simulateurs, and Georgia Institute of Technology, Mr. Michel Selosse has spent five weeks at Georgia Tech to receive specialized training regarding various on-line simulation techniques relating to electric power systems. The purpose of this report is to briefly summarize the educational activities during mr. Selosse's stay at Georgia Tech.

1. Familiarization with the HARRIS 800 Computer System

Mr. Selosse was provided with a computer terminal in his office in the EE building and with full access to the computer facilities of the Microelectronics Center at Georgia Tech, where the Harris 800 computer is located. Instruction was provided as to the general usage of the Harris 800 for editing files, compiling and linking programs, creating macros, and executing batch and interactive programs.

2. Steady-State Analysis

A detailed review of the material presented in 1982, during the seminars offered in Paris by Dr. Puttgen, was first carried out. Particular emphasis was put on the various models to be used. Several computational examples were solved by Mr. Selosse and then discussed. Next, the load-flow problem formulation was discussed and the various solution procedures were presented. Particular emphasis was put on the relationship between the Newton-Raphson, Decoupled and Fast Decoupled load-flow methods. Sparse matrix techniques were extensively discussed.

Mr. Selosse received a number of assignments relating to the practical execution of load-flow studies. The purpose of these assignments was to gain further familiarity with the actual mechanisms of running load-flow studies as far as the preparation of data and analysis of results are concerned. In addition, a number of case studies were carried out, both on base cases and on contingency cases, to highlight the influence of such modeling decisions as the slack bus voltage magnitude and the slack bus location, among others. Both the 30 Bus and the 250 Bus test networks were simulated extensively.

3. Transient Stability Analysis

During his stay, Mr. Selosse attended all lectures of the course EE 6521, Transient Stability, which was offered by Dr. Debs at the graduate level for Georgia Tech students.

With Dr. Dorsey, Mr. Selosse undertook a detailed study of the one machine swing equations with particular emphasis on modeling and solution techniques. Next, a computational example, based on a small two machine network, was actually solved manually by Dr. Dorsey on the black board to provide a full exposure to the entire transient stability analysis solution procedure. Finally, a detailed presentation as to the general computation methodolgy was carried out.

Next, Mr. Selosse carried out a number of stability analysis studies to simulate the impact of various types of faults on the system's behavior. For this purpose, a 30 Bus network was primarily used such that the results could be interpreted physically with some ease. Various swing curve results were discussed and interpreted.

4. Slow Dynamics Studies

Since Mr. Selosse did not have any data with him relating to Thomson-CSF internal efforts, it was decided to implement some of the slow dynamics models at Georgia Tech in conjunction with the existing Fast Decoupled Load Flow program. The resulting program, written by Mr. Selosse with Dr. Puttgen's support and using the existing load-flow package, provided for the following features:

- Real power-frequency controller,
- Network frequency error control, based on the "level" concept,
- Interarea error controls,
- Machine damper winding effects,
- Local group statism,
- Overall system inertia and individual machine inertia.

The said program was developed and tested, primarily using the 30 Bus test case. The effort prooved to be usefull in that it provided some additional insight regarding some of the modeling assumptions used for Thomson-CSF's efforts regarding real-time simulation of electric power systems.

5. Other Activities

In addition, the following activities took place:

- Visit to the Georgia Power Dispatching Center.

- Discussions relating to fast voltage estimation techniques based on adjoint sensitivity methods.

- Discussions of fast contingency analysis methods based on the DC load-flow method and based on various compensation methods.

- Discussions regarding the initial functional specifications for a small network switching dispatcher simulator.

6. Participating Staff

- Dr. John Dorsey, Associate Professor of EE. Transient Stability studies.

- Dr. Hans B. Puttgen, Associate Professor of EE. Steady state analysis and slow dynamics program.

- Ms. Gail Wells. Computer facilities and programming support.

GEORGIA INSTITUTE OF TECHNOLOGY
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November 7, 1985

Monsieur Lesage
Thomson CSF
Division Simulateurs
3 Avenue Albert Einstein
BP 116
78192 Trappes
Cedex
FRANCE

Dear Monsieur Lesage:

Enclosed, please find the monthly report for October.

Sincerely,

H. B. Puttgen

HBP/mjc

Enclosure

2. LOAD FLOW PROGRAM

The load flow program used for the purposes of this project is called FDLF version 100. FDLF has the following features:

- Uses the so-called Fast Decoupled Load Flow formulation first proposed by Stott and Alsac. This means that only the "diagonal" Jacobian submatrices:

  $$\partial P/\partial \delta \text{ and } \partial Q/\partial V$$

  are retained while the "off diagonal" Jacobian submatrices:

  $$\partial P/\partial V \text{ and } \partial Q/\partial \delta$$

  are set to zero.

  Furthermore, the two "diagonal" Jacobian submatrices are kept at their constant values throughout the solution procedure such that:

  $$\partial P/\partial \delta = B' \text{ and } \partial Q/\partial V = B''$$

- Uses an optimum storage technique to minimize the "filling" process during the Gaussian elimination procedure.

- The solution of each of the two decoupled sets of linear equations at each iteration is done by forward-backward substitutions.

- The trigonometric functions required during the load flow formulations are explicitely coded in the program using limited Taylor expansion series rather than relying on Fortran Library functions.

- FDLF is coded in Fortran 77 and is running on a CDC CYBER 180/855 for the purposes of this study. The Fortran compiler optimizer option was used to minimize the required execution time.

2.1. Inputs Required

Program FDLF uses the following input structure, where all data is entered in the so-called free format:

Record 1: General bus data information

NN:	number of nodes
NG:	number of generator buses (PV buses)
SBASE:	base MVA, generally set to 100
EPSP:	absolute mismatch error allowed on real powers
EPSQ:	absolute mismatch error allowed on reactive powers

Record 2: Slack bus data

Bus Name, in alphanumeric format
VS: slack bus voltage magnitude, in pu
θS: slack bus phase angle, in degrees

Records 3 to NG+2: Generator (PV) bus data

Bus Name, in alphanumeric format
PG: real power generation, in MW
QGMIN: minimum reactive power generation bound, in MVAR
QGMAX: maximum reactive power generation bound, in MVAR
PD: real power demand, in MW
QD: reactive power demand, in MVAR
VSPEC: specified voltage magnitude, in pu

Records NG+3 to NN+2: Load bus data

Bus Name, in alphanumeric format
PD: real power demand, in MW
QD: reactive power demand, in MVAR

Record NN+3: General element data information

NL: number of transmission lines
NT: number of transformers
NS: number of shunt elements

Records NN+4 to NN+NL+3: Transmission line data

Starting Bus Name, in alphanumeric format
Ending bus name, in alphanumeric format
RL: transversal resistance, in %, based on SBASE
XL: transversal reactance, in %, based on SBASE
QC: total charging reactive power for the line at 1 pu voltage at both ends

Records NN+NL+4 to NN+NL+NT+3: Transformer data

Starting Bus Name, in alphanumeric format
Ending Bus Name, in alphanumeric format
RT: short circuit resistane, in %, based on SBASE, and referred to the starting bus side
XT: short circuit reactance, in %, based on SBASE and referred to the starting bus side
TAP: turns ratio of the transformer expressed as the ratio of the no-load starting bus voltage to the no-load ending bus voltage.

Records NN+NL+NT+4 to NN+NL+NT+NS+3: Shunt Element Data

Bus name, in alphanumeric format
XS: shunt reactance, given as the reactive power injected into the network by the device at 1 pu voltage (positive for capacitive devices, negative for inductive devices).

2.2 Output Obtained

Using the IEEE 30 bus network as an example, the three major output listings yielded by program FDLF can be described as follows, where the three listings are contained in Appendix A.

2.2.1 Element Data

This listing is separated in three subparts:

- Transmission Lines
NO: Starting Bus Name
NE: Ending Bus Name
R: Transversal resistance, in %, based on SBASE
X: Transversal reactance, in %, based on SBASE
X/R: Ratio provided for comparative purposes
wC: Based on the charging reactive power for the line at 1 pu voltage at both ends
Length: Based on EPRI typical data; see Appendix B

- Transformers
ND: Starting Bus Name
NE: Ending Bus Name
R: Short circuit resistance, in %, based on SBASE and referred to the starting bus side
X: Short circuit reactance, in %, based on SBASE and referred to the starting bus side
Tap: turns ratio of the transformer expressed as the ratio of the no-load starting bus voltage to the no-load lending bus voltage.

- Shunt Elements
NO: Bus Name
wC: Based on the reactive power injection of the device at 1 pu voltage.

2.2.2 Bus Oriented Results

The second output listing is oriented toward the bus results. Initially, some global convergence results are provided:

Time for input: CPU time required to actually read the inputs from a sequential input file and to arrange the data into the appropriate arrays. This time is of no consequence to this project

since it is highly machine dependent and no effort was done to minimize it for example by use of various data base structures.

Time to Compact: CPU time required to carry out the various compaction processes required to minimize the storage requirements. This time is only required once per load-flow solution before the actual iterative solution procedure is started.

Time for Factorization: CPU time required to carry out the actual factorizaton and storage of the two decoupled Fortran submatrices B' and B". This time is only required once per load-flow solution before the actual iterative solution procedure is started.

Number of Iterations: Total number of iterations required to achieve the desired accuracy. Note that one solution of the B' and B" equations constitutes one iteration.

Maximum Mismatch in PU: Maximum real and reactive power mismatches reached at any bus at the solution point.

Time for Solution: CPU time required for the iterative solution procedure itself.

Execution Time: Sum of all CPU times listed up to this point.

Slack Bus Results:
- **Bus Name**
- **Voltage:** magnitude, in pu, and phase angle, in degrees
- **Generation:** PG and QG at the slack bus, in MW and MVAR

PV Bus Results:
- **Bus Name**
- **VSP:** specified voltage in pu
- **Voltage:** magnitude, in pu, and phase angle, in degrees. Note that if the upper reactive power limit has been hit, then the voltage magnitude has a + attached to it; if the lower reactive power unit has been hit, then a - is attached to the voltage magnitude
- **Generation:** PG, as specified, in MW
  QG, as computed, in MVAR
- **QGmin, QGmax:** as specified, in MVAR
- **Load:** PD and QD as specified, in MW and MVAR

Load Bus Results:	
Bus Name	
Voltage:	**Magnitude, in PU and phase angle in degrees.**
Load:	**PD and QD as specified, in MW and MVAR**
Power Generated:	**Sum of all real and reactive power generations, in MW and MVAR**
Power Demanded:	**Sum of all real and reactive power demands, in MW and MVAR**
System Losses:	**Real and Reactive total system losses for the entire system. Note that a negative reactive power loss corresponds to a net reactive power production by the system.**
Printout Time:	**CPU time required to generate all three printout files. Again this time of no consequence for the project on hand.**

2.2.3 Line Flow Results

The last output listing gives all line flows in the following format for each bus in a sequential order starting with the slack bus, then all PV buses, and finally all load buses:

Note that a shunt element is noted as having the same starting and ending bus name.

Net real and reactive power injections (in MW and MVar) as determined from the line flow.

Finally, the system real and reactive losses are again determined along with the actual losses in the transversal admittance elements.

3. LOAD FLOW PROGRAM VALIDATION

In an effort to provide an illustration of Program FDLF's capabilities, the IEEE 118 Bus Network was simulated. In this case, the exact original data, as originally proposed by American Electric Power, AEP, was used. This same network will then be used as the basis for building of the 250-bus test network to be used for this project.

The actual data originally provided by AEP, and which was later used to "normalize" the IEEE 118 bus case is attached in Appendix C. It should be noted that since this data is very old, the so-called Gauss-Seidel solution procedure was used and which explains the rather high number of buses with significant mismatches even at the solution point.

The results obtained using the FDLF program are attached in Appendix D. As will be obvious from a rapid inspection, the two sets of results coincide exactly once the computational errors are taken into account. The two best summaries of overall concordance probably are the real and reactive power system losses:

	AEP	FDLF
P_{Loss}	132.9	132.5
$^{*}Q_{Loss}{}^{*}$(X*I*I)	784.7	781.3

and the slack bus real and reactive power generations:

	AEP	FDLF
P_{Slack}	518.5	513.5
Q_{Slack}	-82.7	-82.40

4. 250 BUS SYSTEM

The required 250 bus test system was constructed using three different IEEE test networks:

IEEE 118 bus network (see Appendix D)

IEEE 30 bus network (see Appendix A)

IEEE 14 bus network (see Appendix E)

4.1 Interconnection Between Subsystems

Using the EPRI standarized line element values for various voltage levels, and the X/R ratios for the various lines in all three IEEE networks, the following conclusions can be reached:

- The IEEE 118 bus network primarily contains transmision lines at the 345 KV level and at the 115-165 KV level.

- The IEEE 30 bus network primarily contains transsmission lines at the 115-165 KV level and at the 33 KV level.

- The IEEE 14 bus network primarily contains transmission lines at the 115-165 KV level and at the 33 KV level.

As a result, the HV portions of the IEEE 30 and IEEE 14 bus networks can be connected with the LV portion of the IEEE 118 bus network.

The final 250 bus system was then constructed as follows:

- The basic IEEE 118 bus system, in which the buses are named Bus 1 through BUS 118. Bus 69 remains the overall system slack bus.

- Four separate IEEE 30 bus networks, in which the buses are named A1 through A30, B1 through B30, C1 through C30, D1 through D30 respectively. Clearly, for each of these networks, the slack bus has been converted into a PV bus.

- One IEEE 14 bus network in which the buses are named E1 thorugh E14. Clearly, the related slack bus has been converted into a PV bus.

Each of these systems, as they are modified, are discussed in the next six subsections as far as their bus models are concerned.

4.1.1 IEEE 118 Bus Network

The IEEE 118 bus system has 50 PV buses in its version used for the 250 bus network. Of these 50 PV buses, 18 are strictly reactive power regulators, i.e, their real power generaton is set to zero. Finally, of the remainng 32 generator buses, three may have negative real power

generations to actually simulate a pump/turbine situation. The number of negative real power generations was significantly reduced from the original IEEE 118 bus case in an effort to arrive at a more realistic network.

In addition, a number of specified voltage magnitudes, VSPEC, were changed with respect to the original IEEE 118 bus data, again to arrive at a more realistic situation.

All real and reactive power demands were kept at their original values as contained in the original IEEE 118 bus data.

4.1.2 IEEE 30 Bus Network A

The A subsystem has 6 true generator buses modeled as PV buses.

In an effort to achieve a more realistic overall network, sme of the specified voltage magnitude VSPEC, and power generatin data have been modified in conjunction with the 250 Bus Network.

The HV portion of system A is connected to the LV portion of the main system as follows:

A1 - Bus 48
A8 - Bus 40
A2 - Bus 45
A28 - Bus 42
A5 - Bus 44

4.1.3 IEEE 30 Bus Network B

The B subsystem has 6 true generator buses modeled as PV buses

In an effort to achieve a more realistic overall network, some of the specified voltage magnitudes, VSPEC, and pwoer generation data have been modified in conjunction with the 250 Bus Network.

The HV portion of system B is connected to the LV portion of the main system as follows:

B1 - Bus 20
B4 - Bus 21
B8 - Bus 22
B28 - Bus 32

4.1.4 IEEE 30 Bus Network C

The C subsystem has 6 true generator buses modeled on PV buses.

In an effort to achieve a more realistic overall network, some of the specified voltage magnitudes, VSPEC, and power generation data have been modified in conjunction with the 250 Bus Network.

The HV portion of system C is connected to the LV portion of hte main system as follows:

C28 - Bus 82
C8 - Bus 83
C5 - Bus 85
C2 - Bus 89
C1 - Bus 92
C4 - Bus 95

4.5.5 IEEE 30 Bus Network D

The D subsystem has 6 true generator buses modeled as PV buses.

In an effort to achieve a more realistic overall network, some of the specified voltage magnitudes, VSPEC, and pwoer generation data have been modified in conjuncton with the 250 Bus Network.

The HV portion of system D is connected to the LV portion of the main system as follows:

D1 - Bus 56
D4 - Bus 51
D5 - Bus 66
D8 - Bus 67
D28 - Bus 59

4.1.6 IEEE 14 Bus Network E

The E subsystem has 4 true generator buses modeled as PV buses.

In an effort to achieve a more realistic overall network, some of the specified voltage magnitudes, VSPEC, and power generation data have been modified in conjunction with the 250 Bus Network.

The HV portion of system E is connected to the LV portion of the main system as follows:

E1 - Bus 102
E2 - Bus 97
E5 - Bus 90

Appendix A

IEEE 30 Bus Network

A.1. Transmission line data
Transformer data
Shunt element data

A.2. Bus oriented results

A.3. Line flow results

Sbase: 100.

Transmission Lines

NO	NE	R %	X %	X/R	wC*Sbase	Length
Bus 1	Bus 2	1.920	5.750	2.99	2.640	29.3
Bus 1	Bus 3	4.520	18.520	4.10	2.040	78.7
Bus 2	Bus 4	5.700	17.370	3.05	1.840	87.6
Bus 3	Bus 4	1.320	3.790	2.87	.420	19.8
Bus 2	Bus 5	4.720	19.830	4.20	2.090	83.1
Bus 2	Bus 6	5.810	17.630	3.03	1.870	89.2
Bus 4	Bus 6	1.190	4.140	3.48	.450	19.3
Bus 5	Bus 7	4.600	11.600	2.52	1.020	66.0
Bus 6	Bus 7	2.670	8.200	3.07	.850	41.2
Bus 6	Bus 8	1.200	4.200	3.50	.450	19.5
Bus 9	Bus 11	.000	20.800			
Bus 9	Bus 10	.000	11.000			
Bus 12	Bus 13	.000	14.000			
Bus 12	Bus 14	12.310	25.590	2.08		16.1
Bus 12	Bus 15	6.620	13.040	1.97		8.4
Bus 12	Bus 16	9.450	19.870	2.10		12.4
Bus 14	Bus 15	22.100	19.970	.90		20.5
Bus 16	Bus 17	8.240	19.320	2.34		11.5
Bus 15	Bus 18	10.700	21.850	2.04		13.8
Bus 18	Bus 19	6.390	12.920	2.02		8.2
Bus 19	Bus 20	3.400	6.800	2.00		4.4
Bus 10	Bus 20	9.360	20.900	2.23		12.7
Bus 10	Bus 17	3.240	8.450	2.61		47.0
Bus 10	Bus 21	3.480	7.490	2.15		4.6
Bus 10	Bus 22	7.270	14.990	2.06		9.4
Bus 21	Bus 22	1.160	2.360	2.03		1.5
Bus 15	Bus 23	10.000	20.200	2.02		12.9
Bus 22	Bus 24	11.500	17.900	1.56		13.1
Bus 23	Bus 24	13.200	27.000	2.05		17.1
Bus 24	Bus 25	18.850	32.920	1.75		22.6
Bus 25	Bus 26	25.440	38.000	1.49		28.4
Bus 25	Bus 27	10.930	20.870	1.91		13.7
Bus 27	Bus 29	21.980	41.530	1.89		27.4
Bus 27	Bus 30	32.020	60.270	1.88		39.8
Bus 29	Bus 30	23.990	45.330	1.89		29.9
Bus 8	Bus 28	6.360	20.000	3.14	2.140	99.0
Bus 6	Bus 28	1.690	5.990	3.54	.650	27.6

Transformers

NO	NE	R %	X %	Tap
Bus 6	Bus 9	.000	20.800	.978
Bus 6	Bus 10	.000	55.600	.969
Bus 4	Bus 12	.000	25.600	.932
Bus 28	Bus 27	.000	39.600	.968

Shunt Elements

NO	wC*Sbase
Bus 10	19.011
Bus 24	4.000

```
    Time for input:    .16
    Time for compact:    .01
    Time for factorization:    .01
No. of iterations:  4.5
Maximum mismatch (in pu):  1.1E-05 8.2E-05
    Time for solution:    .01
Execution time:    .19

S base : 100.
```

Bus	Vsp	Voltage		Generation		QGmin	QGmax	Load	
Bus 1		1.050	.00	98.79	-3.13				
Bus 2	1.045	1.045	-1.85	80.00	47.66	-20.00	60.00	21.70	12.70
Bus 5	1.010	1.010	-6.51	50.00	19.16	-15.00	62.45	94.20	19.00
Bus 8	1.010	1.010	-5.65	20.00	33.75	-15.00	56.57	30.00	30.00
Bus 11	1.050	1.050	-4.56	20.00	7.01	-10.00	45.83	.00	.00
Bus 13	1.050	1.050	-6.32	20.00	3.79	-15.00	56.57	.00	.00

Bus	Voltage		Load	
Bus 3	1.019	-3.77	2.40	1.20
Bus 4	1.012	-4.51	7.60	1.60
Bus 6	1.010	-5.34	.00	.00
Bus 7	1.002	-6.35	22.80	10.90
Bus 9	1.037	-6.75	.00	.00
Bus 10	1.033	-8.67	5.80	2.00
Bus 12	1.045	-7.78	11.20	7.50
Bus 14	1.030	-8.72	6.20	1.60
Bus 15	1.026	-8.85	8.20	2.50
Bus 16	1.033	-8.44	3.50	1.80
Bus 17	1.028	-8.82	9.00	5.80
Bus 18	1.016	-9.50	3.20	.90
Bus 19	1.014	-9.69	9.50	3.40
Bus 20	1.018	-9.49	2.20	.70
Bus 21	1.021	-9.15	17.50	11.20
Bus 22	1.021	-9.15	.00	.00
Bus 23	1.015	-9.34	3.20	1.60
Bus 24	1.010	-9.65	8.70	6.70
Bus 25	1.008	-9.65	.00	.00
Bus 26	.990	-10.08	3.50	2.30
Bus 27	1.016	-9.38	.00	.00
Bus 28	1.005	-5.81	.00	.00
Bus 29	.996	-10.63	2.40	.90
Bus 30	.984	-11.53	10.60	1.90

Power Generated:	288.79	108.25
Power Demanded:	283.40	126.20
System Losses:	5.39	-17.95

Printout time: .15

Bus 1	Bus 2	58.61	-10.90
Bus 1	Bus 3	40.18	7.77
	Total:	98.79	-3.13

Bus 2	Bus 1	-58.00	9.84
Bus 2	Bus 4	31.47	9.03
Bus 2	Bus 5	45.46	8.24
Bus 2	Bus 6	39.36	7.85
	Total:	58.30	34.96

Bus 5	Bus 2	-44.53	-6.54
Bus 5	Bus 7	.33	6.69
	Total:	-44.20	.16

Bus 8	Bus 6	-11.94	3.17
Bus 8	Bus 28	1.94	.58
	Total:	-10.00	3.75

Bus 11	Bus 9	20.00	7.01
	Total:	20.00	7.01

Bus 13	Bus 12	20.00	3.79
	Total:	20.00	3.79

Bus 3	Bus 1	-39.48	-7.11
Bus 3	Bus 4	37.08	5.91
	Total:	-2.40	-1.20

Bus 4	Bus 2	-30.90	-9.24
Bus 4	Bus 3	-36.90	-5.82
Bus 4	Bus 6	34.85	-4.57
Bus 4	Bus 12	25.36	18.03
	Total:	-7.60	-1.60

Bus 6	Bus 2	-38.50	-7.20
Bus 6	Bus 4	-34.71	4.60
Bus 6	Bus 7	22.63	2.79
Bus 6	Bus 8	11.96	-3.57
Bus 6	Bus 28	14.72	3.23
Bus 6	Bus 9	12.65	-1.89
Bus 6	Bus 10	11.25	2.03
	Total:	.00	.00

s 7	Bus 5	-.30	-7.67
s 7	Bus 6	-22.50	-3.23
	Total:	-22.80	-10.90

s 9	Bus 11	-20.00	-6.17
s 9	Bus 10	32.65	3.96
s 9	Bus 6	-12.65	2.21
	Total:	.00	.00

s 10	Bus 9	-32.65	-2.85
s 10	Bus 20	8.89	3.78
s 10	Bus 17	4.98	4.84
s 10	Bus 21	16.28	9.58
s 10	Bus 22	7.94	4.31
s 10	Bus 6	-11.25	-1.36
s 10	Bus 10	.00	-20.30
	Total:	-5.80	-2.00

s 12	Bus 13	-20.00	-3.26
s 12	Bus 14	8.01	2.29
s 12	Bus 15	18.54	6.45
s 12	Bus 16	7.61	2.95
s 12	Bus 4	-25.36	-15.93
	Total:	-11.20	-7.50

s 14	Bus 12	-7.93	-2.13
s 14	Bus 15	1.73	.53
	Total:	-6.20	-1.60

s 15	Bus 12	-18.31	-5.99
s 15	Bus 14	-1.72	-.52
s 15	Bus 18	6.16	1.54
s 15	Bus 23	5.67	2.48
	Total:	-8.20	-2.50

s 16	Bus 12	-7.55	-2.83
s 16	Bus 17	4.05	1.03
	Total:	-3.50	-1.80

s 17	Bus 16	-4.04	-1.00
s 17	Bus 10	-4.96	-4.80
	Total:	-9.00	-5.80

Bus 18	Bus 15	-6.11	-1.45
Bus 18	Bus 19	2.91	.55
	Total:	-3.20	-.90

Bus 19	Bus 18	-2.91	-.54
Bus 19	Bus 20	-6.59	-2.86
	Total:	-9.50	-3.40

Bus 20	Bus 19	6.61	2.89
Bus 20	Bus 10	-8.81	-3.59
	Total:	-2.20	-.70

Bus 21	Bus 10	-16.17	-9.33
Bus 21	Bus 22	-1.33	-1.87
	Total:	-17.50	-11.20

Bus 22	Bus 10	-7.89	-4.20
Bus 22	Bus 21	1.33	1.87
Bus 22	Bus 24	6.55	2.33
	Total:	.00	.00

Bus 23	Bus 15	-5.64	-2.40
Bus 23	Bus 24	2.44	.80
	Total:	-3.20	-1.60

Bus 24	Bus 22	-6.50	-2.24
Bus 24	Bus 23	-2.43	-.78
Bus 24	Bus 25	.23	.41
Bus 24	Bus 24	.00	-4.08
	Total:	-8.70	-6.70

Bus 25	Bus 24	-.23	-.41
Bus 25	Bus 26	3.55	2.37
Bus 25	Bus 27	-3.32	-1.96
	Total:	.00	.00

Bus 26	Bus 25	-3.50	-2.30
	Total:	-3.50	-2.30

Bus 27	Bus 25	3.33	1.99
Bus 27	Bus 29	6.19	1.67

s 27	Bus 30	7.09	1.67
s 27	Bus 28	-16.62	-5.33
	Total:	.00	.00
s 28	Bus 8	-1.94	-2.74
s 28	Bus 6	-14.68	-3.76
s 28	Bus 27	16.62	6.50
	Total:	.00	.00
s 29	Bus 27	-6.10	-1.51
s 29	Bus 30	3.70	.61
	Total:	-2.40	-.90
s 30	Bus 27	-6.93	-1.36
s 30	Bus 29	-3.67	-.54
	Total:	-10.60	-1.90
stem losses:		5.39	-17.95

Appendix B

EPRI Based

Typical Transmission Line Data

Using the EPRI report on

"Synthetic Electric Utility Systems for Evaluating Advanced Technologies"

EPRI EM-285
Project TPS-75-615
February 1977, Final Report

the following data is extracted:

Line KV	R %/mile	X %/mile	X/R	Admittance %/mile
33	1.25	2.5	X/R < 2.5	0.004
115-161	0.0845	0.413	2.5 < X/R < 8	0.104
230	0.0245	0.152	5.5 < X/R < 8	0.285
345	0.00468	0.050	8 < X/R < 14	0.858
500 and up	0.00126	0.0245	X/R > 14	1.74

Appendix C

IEEE (AEP) 118 Bus Networks

Raw Data

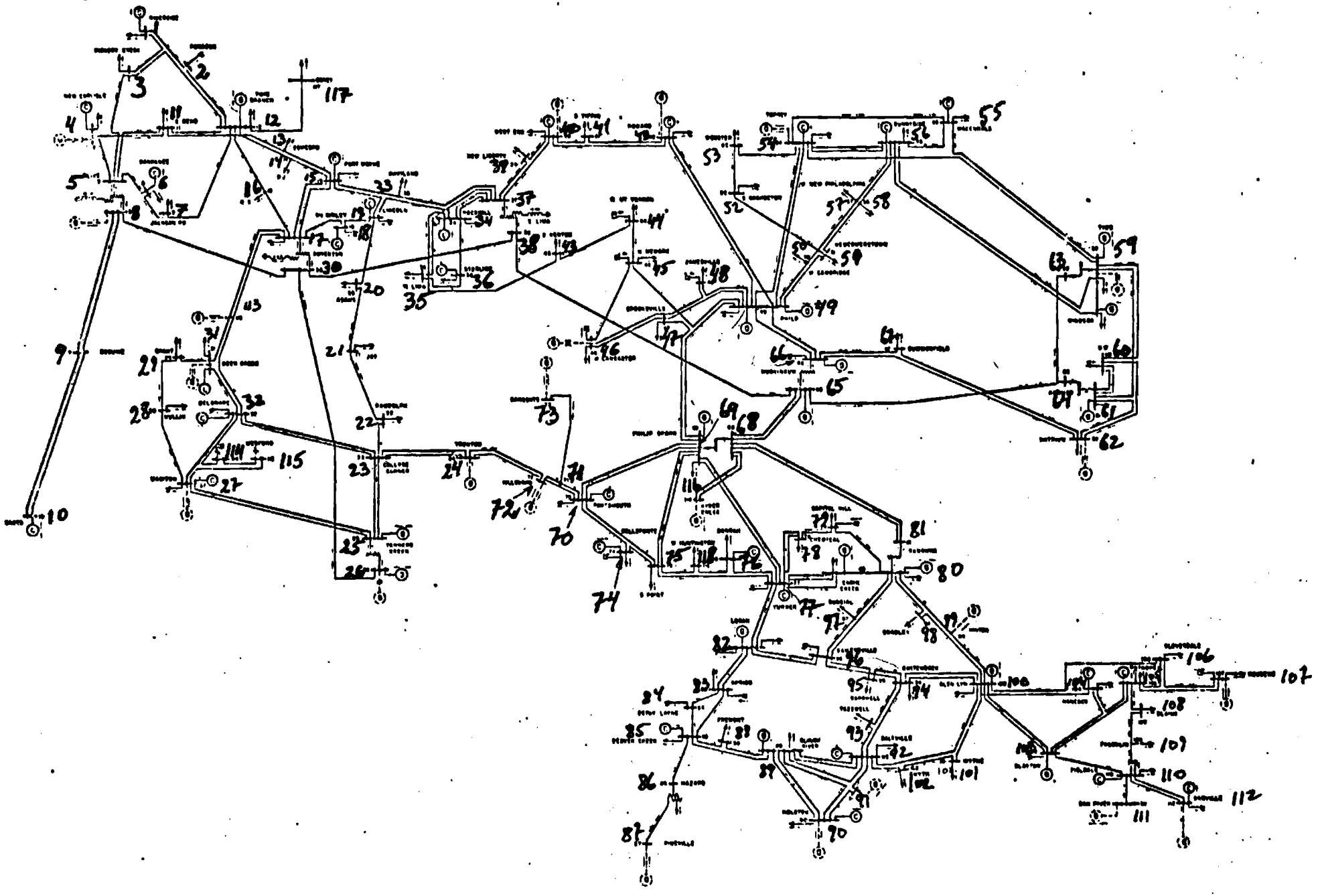
Appendix C

IEEE (AEP) 118 Bus Networks

Raw Data

AEP 118 BUS TEST SYSTEM

The data for this system, part of American Electric Power, is being made available to the electric utility industry as a standard test case for evaluating various analytical methods and computer programs for the solution of power networks. If further information is desired, please contact Mr. Glenn W. Stagg, American Electric Power Service Corporation, 2 Broadway, New York 8, New York, HAnover 2-4800, Ext. 640.



AEP 118 BUS TEST SYSTEM BUS CODE DIAGRAM

AEP 118 BUS TEST SYSTEM

OPERATING CONDITIONS

Bus Number	Starting Bus Voltage Magnitude Per Unit	Starting Bus Voltage Phase Angle Degrees	Generation Mw	Generation Mvar	Load Mw	Load Mvar
1	1.0	0	0	0	51	27
2	1.0	0	0	0	20	9
3	1.0	0	0	0	39	10
4	1.0	0	-9	0	30	12
5	1.0	0	0	0	0	0
6	1.0	0	0	0	52	22
7	1.0	0	0	0	19	2
8	1.0	0	-28	0	0	0
9	1.0	0	0	0	0	0
10	1.0	0	450	0	0	0
11	1.0	0	0	0	70	23
12	1.0	0	85	0	47	10
13	1.0	0	0	0	34	16
14	1.0	0	0	0	14	1
15	1.0	0	0	0	90	30
16	1.0	0	0	0	25	10
17	1.0	0	0	0	11	3
18	1.0	0	0	0	60	34
19	1.0	0	0	0	45	25
20	1.0	0	0	0	18	3
21	1.0	0	0	0	14	8
22	1.0	0	0	0	10	5
23	1.0	0	0	0	7	3
24	1.0	0	-13	0	0	0
25	1.0	0	220	0	0	0
26	1.0	0	314	0	0	0
27	1.0	0	-9	0	62	13
28	1.0	0	0	0	17	7
29	1.0	0	0	0	24	4
30	1.0	0	0	0	0	0
31	1.0	0	7	0	43	27
32	1.0	0	0	0	59	23
33	1.0	0	0	0	23	9
34	1.0	0	0	0	59	26
35	1.0	0	0	0	33	9
36	1.0	0	0	0	31	17
37	1.0	0	0	0	0	0
38	1.0	0	0	0	0	0
39	1.0	0	0	0	27	11
40	1.0	0	-46	0	20	23
41	1.0	0	0	0	37	10
42	1.0	0	-59	0	37	23
43	1.0	0	0	0	18	7
44	1.0	0	0	0	16	8
45	1.0	0	0	0	53	22
46	1.0	0	19	0	28	10
47	1.0	0	0	0	34	0

AEP 118 BUST TEST SYSTEM
OPERATING CONDITIONS Contd.

Bus Number	Starting Bus Voltage: Magnitude Per Unit	Starting Bus Voltage: Phase Angle Degrees	Generation: Mw	Generation: Mvar	Load: Mw	Load: Mvar
48	1.0	0	0	0	20	11
49	1.0	0	204	0	87	30
50	1.0	0	0	0	17	4
51	1.0	0	0	0	17	8
52	1.0	0	0	0	18	5
53	1.0	0	0	0	23	11
54	1.0	0	48	0	113	32
55	1.0	0	0	0	63	22
56	1.0	0	0	0	84	18
57	1.0	0	0	0	12	3
58	1.0	0	0	0	12	3
59	1.0	0	155	0	277	113
60	1.0	0	0	0	78	3
61	1.0	0	160	0	0	0
62	1.0	0	0	0	77	14
63	1.0	0	0	0	0	0
64	1.0	0	0	0	0	0
65	1.0	0	391	0	0	0
66	1.0	0	392	0	39	18
67	1.0	0	0	0	28	7
68	1.0	0	0	0	0	0
69 *	1.035	30	516.4	0	0	0
70	1.0	0	0	0	66	20
71	1.0	0	0	0	0	0
72	1.0	0	-12	0	0	0
73	1.0	0	-6	0	0	0
74	1.0	0	0	0	68	27
75	1.0	0	0	0	47	11
76	1.0	0	0	0	68	36
77	1.0	0	0	0	61	28
78	1.0	0	0	0	71	26
79	1.0	0	0	0	39	32
80	1.0	0	477	0	130	26
81	1.0	0	0	0	0	0
82	1.0	0	0	0	54	27
83	1.0	0	0	0	20	10
84	1.0	0	0	0	11	7
85	1.0	0	0	0	24	15
86	1.0	0	0	0	21	10
87	1.0	0	4	0	0	0
88	1.0	0	0	0	48	10
89	1.0	0	607	0	0	0
90	1.0	0	-85	0	78	42
91	1.0	0	-10	0	0	0
92	1.0	0	0	0	65	10
93	1.0	0	0	0	12	7
94	1.0	0	0	0	30	16
95	1.0	0	0	0	42	31
96	1.0	0	0	0	38	15
97	1.0	0	0	0	15	9
98	1.0	0	0	0	34	8

* Swing machine

AEP 118 BUS TEST SYSTEM
OPERATING CONDITIONS Contd.

Bus Number	Starting Bus Voltage Magnitude Per Unit	Starting Bus Voltage Phase Angle Degrees	Generation Mw	Generation Mvar	Load Mw	Load Mvar
99	1.0	0	-42	0	0	0
100	1.0	0	252	0	37	18
101	1.0	0	0	0	22	15
102	1.0	0	0	0	5	3
103	1.0	0	40	0	23	16
104	1.0	0	0	0	38	25
105	1.0	0	0	0	31	26
106	1.0	0	0	0	43	16
107	1.0	0	-22	0	28	12
108	1.0	0	0	0	2	1
109	1.0	0	0	0	8	3
110	1.0	0	0	0	39	30
111	1.0	0	36	0	0	0
112	1.0	0	-43	0	25	13
113	1.0	0	-6	0	0	0
114	1.0	0	0	0	8	3
115	1.0	0	0	0	22	7
116	1.0	0	-184	0	0	0
117	1.0	0	0	0	20	8
118	1.0	0	0	0	33	15

AEP 118 BUS TEST SYSTEM *
IMPEDANCE AND LINE CHARGING DATA

Line Designation	Resistance Per Unit**	Reactance Per Unit**	Line Charging Per Unit**
1 - 2	.03030	.09990	.01270
1 - 3	.01290	.04240	.00542
4 - 5	.00176	.00798	.00105
3 - 5	.02410	.10800	.01420
5 - 6	.01150	.05400	.00713
6 - 7	.00459	.02080	.00275
8 - 9	.00244	.03050	.58100
5 - 8	0	.02670	.955 0
9 - 10	.00258	.03220	.61500
4 - 11	.02090	.06880	.00874
5 - 11	.02030	.06820	.00869
11- 12	.00595	.01960	.00251
2 - 12	.01870	.06160	.00786
3 - 12	.04840	.16000	.02030
7 - 12	.00862	.03400	.00437
11- 13	.02225	.07310	.00938
12- 14	.02150	.07070	.00908
13- 15	.07440	.24440	.03134
14- 15	.05950	.19500	.02510
12- 16	.02120	.08340	.01070
15- 17	.01320	.04370	.02220
16- 17	.04540	.18010	.02330
17- 18	.01230	.05050	.00649
18- 19	.01119	.04930	.00571
19- 20	.02520	.11700	.01490
15- 19	.01200	.03940	.00505
20- 21	.01830	.08490	.01080
21- 22	.02090	.09700	.01230
22- 23	.03420	.15900	.02020
23- 24	.01350	.04920	.02490
23- 25	.01560	.08000	.04320
25- 26	0	.03820	.96 0
25- 27	.03180	.16300	.08820
27- 28	.01913	.08550	.01080
28- 29	.02370	.09430	.01190
17- 30	0	.03880	.96 0
8 - 30	.00431	.05040	.25700
26- 30	.00799	.08600	.45400
17- 31	.04740	.15630	.01995
29- 31	.01080	.03310	.00415
23- 32	.03170	.11530	.05865
31- 32	.02980	.09850	.01255
27- 32	.02290	.07550	.00963
15- 33	.03800	.12440	.01597
19- 34	.07520	.24700	.03160
35- 36	.00224	.01020	.00134
35- 37	.01100	.04970	.00659
33- 37	.04150	.14200	.01830
34- 36	.00871	.02680	.00284

AEP 118 BUS TEST SYSTEM
IMPEDANCE AND LINE CHARGING DATA Contd.

Line Designation	Resistance Per Unit**	Reactance Per Unit**	Line Charging Per Unit**
34- 37	.00256	.00940	.00492
37- 38	0	.03750	- 155 0
37- 39	.03210	.10600	.01350
37- 40	.05930	.16800	.02100
30- 38	.00464	.05400	.21100
39- 40	.01840	.06050	.00776
40- 41	.01450	.04870	.00611
40- 42	.05550	.18300	.02330
41- 42	.04100	.13500	.01720
43- 44	.06080	.24540	.03034
34- 43	.04130	.16810	.02113
44- 45	.02240	.09010	.01120
45- 46	.04000	.13560	.01660
46- 47	.03800	.12700	.01580
46- 48	.06010	.18900	.02360
47- 49	.01910	.06250	.00802
42- 49	.07150	.32300	.04300
42- 49	.07150	.32300	.04300
45- 49	.06840	.18600	.02220
48- 49	.01790	.05050	.00629
49- 50	.02670	.07520	.00937
49- 51	.04860	.13700	.01710
51- 52	.02030	.05880	.00698
52- 53	.04050	.16350	.02029
53- 54	.02630	.12200	.01550
49- 54	.07300	.28900	.03690
49- 54	.08690	.29100	.03650
54- 55	.01690	.07070	.01010
54- 56	.00275	.00955	.00366
55- 56	.00488	.01510	.00187
56- 57	.03430	.09660	.01210
50- 57	.04740	.13400	.01660
56- 58	.03430	.09660	.01210
51- 58	.02550	.07190	.00894
54- 59	.05030	.22930	.02990
56- 59	.08250	.25100	.02845
56- 59	.08030	.23900	.02680
55- 59	.04739	.21580	.02823
59- 60	.03170	.14500	.01880
59- 61	.03280	.15000	.01940
60- 61	.00264	.01350	.00728
60- 62	.01230	.05610	.0073
61- 62	.00824	.03760	.00490
59- 63	0	.03860	0
63- 64	.00172	.02000	.10800
61- 64	0	.02680	0
38- 65	.00901	.09860	.52300
64- 65	.00269	.03020	.19000
49- 66	.01800	.09190	.01240
49- 66	.01800	.09190	.01240
62- 66	.04620	.21800	.02890
62- 67	.02580	.11700	.01550

AEP 118 BUS TEST SYSTEM
IMPEDANCE AND LINE CHARGING DATA Contd.

Line Designation	Resistance Per Unit **	Reactance Per Unit**	Line Charging Per Unit**
65- 66	0	.03700	.935 0
66- 67	.02240	.10150	.01341
65- 68	.00138	.01600	.31900
47- 69	.08440	.27780	.03546
49- 69	.09850	.32400	.04140
68- 69	0	.03700	.935 0
69- 70	.03000	.12700	.06100
24- 70	.10221	.41150	.05099
70- 71	.00882	.03550	.00439
24- 72	.04880	.19600	.02440
71- 72	.04460	.18000	.02222
71- 73	.00866	.04540	.00589
70- 74	.04010	.13230	.01684
70- 75	.04280	.14100	.01800
69- 75	.04050	.12200	.06200
74- 75	.01230	.04060	.00517
76- 77	.04440	.14800	.01840
69- 77	.03090	.10100	.05190
75- 77	.06010	.19990	.02489
77- 78	.00376	.01240	.00632
78- 79	.00546	.02440	.00324
77- 80	.01700	.04850	.02360
77- 80	.02910	.10500	.01140
79- 80	.01560	.07010	.00935
68- 81	.00175	.02020	.40400
80- 81	0	.03700	.935 0
77- 82	.02980	.08530	.04087
82- 83	.01120	.03665	.01898
83- 84	.06250	.13200	.01290
83- 85	.04300	.14800	.01740
84- 85	.03020	.06410	.00617
85- 86	.03500	.12300	.01380
86- 87	.02828	.20740	.02225
85- 88	.02000	.10200	.01380
85- 89	.02390	.17300	.02350
88- 89	.01390	.07120	.00967
89- 90	.05180	.18800	.02640
89- 90	.02380	.09970	.05300
90- 91	.02540	.08360	.01070
89- 92	.00990	.05050	.02740
89- 92	.03930	.15810	.02070
91- 92	.03870	.12720	.01634
92- 93	.02580	.08480	.01090
92- 94	.04810	.15800	.02030
93- 94	.02230	.07320	.00938
94- 95	.01320	.04340	.00555
80- 96	.03560	.18200	.02470

AEP 118 BUS TEST SYSTEM
IMPEDANCE AND LINE CHARGING DATA Contd.

Line Designation	Resistance Per Unit**	Reactance Per Unit**	Line Charging Per Unit**
82- 96	.01620	.05300	.02720
94- 96	.02690	.08690	.01150
80- 97	.01830	.09340	.01270
80- 98	.02380	.10800	.01430
80- 99	.04540	.20600	.02730
92- 100	.06480	.29500	.03860
94- 100	.01780	.05800	.03020
95- 96	.01710	.05470	.00737
96- 97	.01730	.08850	.01200
98- 100	.03970	.17900	.02380
99- 100	.01800	.08130	.01080
100- 101	.02770	.12620	.01640
92- 102	.01230	.05590	.00732
101- 102	.02460	.11200	.01470
100- 103	.01600	.05250	.02680
100- 104	.04510	.20400	.02705
103- 104	.04660	.15840	.02035
103- 105	.05350	.16250	.02040
100- 106	.06050	.22900	.03100
104- 105	.00994	.03780	.00493
105- 106	.01400	.05470	.00717
105- 107	.05300	.18300	.02360
105- 108	.02610	.07030	.00922
106- 107	.05300	.18300	.02360
108- 109	.01050	.02880	.00380
103- 110	.03906	.18130	.02305
109- 110	.02780	.07620	.01010
110- 111	.02200	.07550	.01000
110- 112	.02470	.06400	.03100
17- 113	.00913	.03010	.00384
32- 113	.06150	.20300	.02590
32- 114	.01350	.06120	.00814
27- 115	.01640	.07410	.00986
114- 115	.00230	.01040	.00138
68- 116	.00034	.00405	.08200
12- 117	.03290	.14000	.01790
75- 118	.01450	.01810	.00599
76- 118	.01640	.05440	.00678

* Based on AEP System for Total Loss Formula June 1962

** Impedance and line-charging susceptance in per unit on a 100,000 kva base

Line charging one-half of total charging of line

CH

AEP 118 BUS TEST SYSTEM

REGULATED BUS DATA

53

Bus Number	Voltage Magnitude Per Unit	Minimum Mvar Capability	Maximum Mvar Capability
1	.955	-5	15
4	.998	-300	300
6	.99	-13	50
8	1.015	-300	300
10	1.05	-147	200
12	.99	-35	120
15	.97	-10	30
18	.973	-16	50
19	.962	-8	24
24	.992	-300	300
25	1.05	-47	140
26	1.015	-1000	1000
27	.968	-300	300
31	.967	-300	300
32	.963	-14	42
34	.984	-8	24
36	.98	-8	24
40	.97	-300	300
42	.985	-300	300
46	1.005	-100	100
49	1.025	-85	210
54	.955	-300	300
55	.952	-8	23
56	.954	-8	15
59	.985	-60	180
61	.995	-100	300
62	.998	-20	20
65	1.005	-67	200
66	1.05	-67	200
70	.984	-10	32
72	.98	-100	100
73	.991	-100	100
74	.958	-6	9
76	.943	-8	23
77	1.006	-20	70
80	1.04	-165	280
85	.985	-8	23
87	1.015	-100	1000
89	1.005	-210	300
90	.985	-300	300
91	.98	-100	100
92	.99	-3	9
99	1.01	-100	100

AEP 118 BUS TEST SYSTEM
REGULATED BUS DATA Contd.

Bus Number	Voltage Magnitude Per Unit	Minimum Mvar Capability	Maximum Mvar Capability
100	1.017	-50	155
103	1.01	-15	40
104	.971	-8	23
105	.965	-8	23
107	.952	-200	200
110	.973	-8	23
111	.98	-100	1000
112	.975	-100	1000
113	.993	-100	200
116	1.005	-1000	1000

AEP 118 BUS TEST SYSTEM
TRANSFORMER DATA

Transformer Designation	Tap Setting*
8-5	.985
26-25	.96
30-17	.96
38-37	.935
63-59	.96
64-61	.985
65-66	.935
68-69	.935
81-80	.935

* Off-nominal turns ratio, as determined by the actual transformer tap positions and the voltage bases. In the case of nominal turns ratio, this would equal 1.

AEP 113 BUS TEST SYSTE'
STATIC CAPACITOR DATA

Bus Number	Susceptance Per Unit*
5	-.4
17	0
34	.14
37	-.25
44	.1
45	.1
46	.1
48	.15
74	.12
79	.2
82	.2
83	.1
105	.2
107	.06
110	.06

* Susceptance in per unit on a 100,000-kva base

AEP 118 BUS TEST SYSTEM
LOAD FLOW SOLUTION

The results of the test load flow are listed in the following pages. Data pertinent to each bus of the system is listed with the corresponding bus number which, in turn, refers to the original bus coding diagram. Printed from left to right following each bus number, and in this order, is bus voltage in per unit, phase angle in degrees, system generation in megawatts and megavars, and bus load in megawatts and megavars. Where static capacitors or shunt reactors are connected to the bus, their contribution in megavars is also specified (plus for capacitors, minus for reactors).

Power and reactive flows in and out of each bus are tabulated under that bus number and are designated by the bus numbers at the far ends of the circuits. Plus values indicate flow of power and reactive out of a bus, and minus values indicate flow into a bus. Tap settings are printed next to those flows which represent transformer loadings. The tap is listed only once and for that bus on which the tap is represented.

The location of the swing machine, megawatt and megavar losses and the mismatch are printed following the information pertaining to the last bus. The mismatch in megawatts and megavars is listed next for each bus of the system in order of the bus numbers. It is the net difference in the flow of power or reactive in and out of a particular bus and is a test of the accuracy of the results. The final figures, following the mismatch, are the number of iterations, and the total and average mismatch excluding the swing machine. The large mismatch value for the swing bus results from not estimating the value of its generation.

Following the load flow output is a listing of the original line and transformer impedance data followed by an ordered double entry list of line and transformer admittances.

AEP 118 BUS TEST SYSTEM
CASE 1 1962 LOADS

BASE CASE

BUS	1	.955	10.67	.0	-3.0	51.00	27.00	
	2	-12.5	-13.0					
	3	-38.8	-17.0					
BUS	2	.971	11.22	.0	.0	20.00	9.00	
	1	12.6	11.0					
	12	-32.6	-19.9					
BUS	3	.968	11.56	.0	.0	39.00	10.00	
	1	39.1	16.8					
	5	-68.2	-14.5					
	12	-9.9	-12.4					
BUS	4	.998	15.28	-9.0	-14.8	30.00	12.00	
	5	-104.4	-26.6					
	11	64.1	-.2					
BUS	5	1.002	15.73	.0	.0	.00	.00	-40.16
	3	69.4	17.3					
	4	104.6	27.3					
	6	88.6	4.1					
	8	-339.5	-91.9					
	11	77.2	3.0					
BUS	6	.990	13.00	.0	16.1	52.00	22.00	
	5	-87.6	-1.3					
	7	35.3	-4.7					
BUS	7	.989	12.56	.0	.0	19.00	2.00	
	6	-35.2	4.5					
	12	16.3	-6.5					
BUS	8	1.015	20.77	-28.0	62.9	.00	.00	
	5	339.5	124.8	TAP	.985			
	9	-440.7	-89.7					
	30	73.0	27.9					
BUS	9	1.043	28.02	.0	.0	.00	.00	
	8	445.4	24.5					
	10	-445.4	-24.4					
BUS	10	1.050	35.61	450.0	-51.1	.00	.00	
	9	450.2	-51.1					
BUS	11	.985	12.72	.0	.0	70.00	23.00	
	4	-63.2	1.3					
	5	-76.0	-.6					
	12	54.0	-35.0					
	13	34.8	11.5					
BUS	12	.990	12.20	85.0	91.6	47.00	10.00	
	2	32.9	19.4					
	3	10.0	8.8					
	7	-16.3	5.7					
	11	-33.9	35.0					
	14	18.1	2.7					
	16	7.3	4.3					
	117	20.1	5.2					

BUS	13	.968	11.35	.0	.0	34.00	16.00	
	11	-34.5	-12.2					
	15	.6	-3.8					
BUS	14	.984	11.50	.0	.0	14.00	1.00	
	12	-18.0	-4.2					
	15	4.0	3.2					
BUS	15	.970	11.23	.0	3.3	90.00	30.00	
	13	-.6	-2.1					
	14	-4.0	-7.9					
	17	-103.8	-24.4					
	19	11.1	12.5					
	33	6.9	-4.8					
BUS	16	.984	11.91	.0	.0	25.00	10.00	
	12	-7.3	-6.4					
	17	-17.7	-3.6					
BUS	17	.995	13.74	.0	.0	11.00	3.00	.00
	15	105.3	25.3					
	16	17.9	-.3					
	18	80.2	24.9					
	30	-231.7	-70.4					
	31	14.8	11.5					
	113	1.9	6.1					
BUS	18	.973	11.53	.0	25.4	60.00	34.00	
	17	-79.4	-22.5					
	19	19.3	13.9					
BUS	19	.963	11.05	.0	-8.0	45.00	25.00	
	15	-11.0	-13.3					
	18	-19.2	-14.6					
	20	-10.6	5.4					
	34	-3.9	-10.5					
BUS	20	.958	11.93	.0	.0	18.00	3.00	
	19	10.7	-8.0					
	21	-28.7	5.0					
BUS	21	.959	13.52	.0	.0	14.00	8.00	
	20	28.9	-6.2					
	22	-42.9	-1.8					
BUS	22	.970	16.08	.0	.0	10.00	5.00	
	21	43.3	1.5					
	23	-53.3	-6.5					
BUS	23	1.000	21.00	.0	.0	7.00	3.00	
	22	54.4	7.4					
	24	7.6	11.0					
	25	-162.4	-26.0					
	32	93.2	4.7					
BUS	24	.992	20.89	-13.0	-13.7	.00	.00	
	23	-7.6	-15.8					
	70	-6.1	-1.5					
	72	.7	3.5					
BUS	25	1.050	27.93	220.0	49.8	.00	.00	
	23	166.6	38.4					
	26	-90.4	-18.6					
	27	143.6	30.1					
BUS	26	1.015	29.71	314.0	9.9	.00	.00	

	25	90.4	21.6	TAP .960			
	30	223.6	-11.7				
BUS 27	.968	15.35	-9.0	3.0	62.00	13.00	
	25	-137.2	-15.2				
	28	32.9	-.6				
	32	12.4	1.1				
	115	20.7	4.7				
BUS 28	.962	13.62	.0	.0	17.00	7.00	
	27	-32.7	-.4				
	29	15.6	-6.6				
BUS 29	.963	12.63	.0	.0	24.00	4.00	
	28	-15.6	4.6				
	31	-8.6	-8.6				
BUS 30	.986	18.79	.0	.0	.00	.00	
	8	-72.7	-75.2				
	17	231.7	93.4	TAP .960			
	26	-219.6	-36.4				
	38	60.9	18.3				
BUS 31	.967	12.75	7.0	32.1	43.00	27.00	
	17	-14.6	-14.7				
	29	8.6	7.9				
	32	-29.9	11.8				
BUS 32	.964	14.80	.0	-14.0	59.00	23.00	
	23	-90.4	-5.8				
	27	-12.4	-2.7				
	31	30.2	-13.1				
	113	4.1	-17.5				
	114	9.5	2.1				
BUS 33	.972	10.63	.0	.0	23.00	9.00	
	15	-6.9	1.8				
	37	-16.1	-10.8				
BUS 34	.986	11.30	.0	-8.0	59.00	26.00	13.61
	19	4.0	4.7				
	36	30.4	11.4				
	37	-95.3	-38.3				
	43	1.1	2.0				
BUS 35	.981	10.87	.0	.0	33.00	9.00	
	36	.2	6.3				
	37	-33.9	-15.2				
BUS 36	.980	10.87	.0	-.9	31.00	17.00	
	34	-30.3	-11.7				
	35	-.2	-6.6				
BUS 37	.992	11.77	.0	.0	.00	.00	-24.60
	33	16.3	7.8				
	34	95.6	38.4				
	35	34.0	14.6				
	38	-244.2	-86.4				
	39	54.7	3.8				
	40	43.8	-2.9				
BUS 38	.962	16.91	.0	.0	.00	.00	
	30	-60.6	-55.4				
	37	244.2	112.0	TAP .935			
	65	-183.4	-56.5				

BUS	39	.970	8.41	.0	.0	27.00	11.00	
	37	-53.7	-3.1					
	40	26.7	-7.9					
BUS	40	.970	7.35	-46.0	27.0	20.00	23.00	
	37	-42.7	2.1					
	39	-26.5	6.9					
	41	15.3	1.3					
	42	-12.1	-6.4					
BUS	41	.967	6.92	.0	.0	37.00	10.00	
	40	-15.2	-2.3					
	42	-21.7	-7.7					
BUS	42	.985	8.53	-59.0	41.1	37.00	23.00	
	40	12.2	2.2					
	41	22.0	5.2					
	49	-65.1	5.3					
	49	-65.1	5.3					
BUS	43	.978	11.28	.0	.0	18.00	7.00	
	34	-1.1	-6.1					
	44	-16.9	-.9					
BUS	44	.985	13.82	.0	.0	16.00	8.00	9.70
	43	17.1	-4.2					
	45	-33.1	5.9					
BUS	45	.987	15.67	.0	.0	53.00	22.00	9.73
	44	33.3	-7.0					
	46	-36.5	-3.4					
	49	-49.9	-1.9					
BUS	46	1.005	18.49	19.0	-5.1	28.00	10.00	10.10
	45	37.0	1.9					
	47	-31.3	-1.1					
	48	-14.8	-5.8					
BUS	47	1.017	20.73	.0	.0	34.00	.00	
	46	31.6	-.9					
	49	-9.3	-11.0					
	69	-56.4	11.8					
BUS	48	1.021	19.93	.0	.0	20.00	11.00	15.63
	46	14.9	1.4					
	49	-35.0	3.2					
BUS	49	1.025	20.94	204.0	116.1	87.00	30.00	
	42	68.2	.4					
	42	68.2	.4					
	45	51.6	2.2					
	47	9.4	9.4					
	48	35.2	-3.9					
	50	52.7	13.4					
	51	66.7	20.4					
	54	37.8	13.1					
	54	37.8	11.2					
	66	-132.3	4.4					
	66	-132.3	4.4					
	69	-46.9	10.8					
BUS	50	1.001	18.90	.0	.0	17.00	4.00	
	49	-52.9	-13.1					
	57	35.9	9.1					
BUS	51	.967	16.28	.0	.0	17.00	8.00	

	49	-64.4	-17.4				
	52	28.6	6.2				
	58	18.8	3.2				
BUS 52	.957	15.32	.0	.0	18.00	5.00	
	51	-28.4	-7.0				
	53	10.4	2.0				
BUS 53	.946	14.35	.0	.0	23.00	11.00	
	52	-10.3	-5.4				
	54	-12.7	-5.6				
BUS 54	.955	15.26	48.0	4.0	113.00	32.00	
	49	-36.6	-15.6				
	49	-36.4	-13.8				
	53	12.7	3.0				
	55	7.1	1.5				
	56	18.3	4.4				
	59	-30.4	-7.5				
BUS 55	.952	14.97	.0	4.7	63.00	22.00	
	54	-7.1	-3.2				
	56	-21.5	-5.8				
	59	-34.6	-8.2				
BUS 56	.954	15.16	.0	-2.1	84.00	18.00	
	54	-18.3	-5.0				
	55	21.6	5.5				
	57	-23.0	-9.1				
	58	-6.7	-3.7				
	59	-28.0	-4.2				
	59	-29.3	-3.9				
BUS 57	.971	16.36	.0	.0	12.00	3.00	
	50	-35.2	-10.5				
	56	23.3	7.5				
BUS 58	.959	15.51	.0	.0	12.00	3.00	
	51	-18.7	-4.5				
	56	6.7	1.5				
BUS 59	.985	19.37	155.0	76.9	277.00	113.00	
	54	30.9	4.3				
	55	35.2	5.9				
	56	28.7	1.0				
	56	30.1	1.1				
	60	-43.3	3.6				
	61	-51.8	5.0				
	63	-151.9	-57.0				
BUS 60	.993	23.15	.0	.0	78.00	3.00	
	59	44.0	-4.4				
	61	-112.2	8.6				
	62	-9.9	-7.1				
BUS 61	.995	24.04	160.0	-40.3	.00	.00	
	59	52.7	-4.6				
	60	112.6	-8.3				
	62	25.4	-13.8				
	64	-30.7	-13.7				
BUS 62	.998	23.43	.0	1.3	77.00	14.00	
	60	10.0	5.7				
	61	-25.4	13.2				
	66	-37.2	-17.3				
	67	-24.3	-14.4				

BUS	63	.969	22.75	.0	.0	.00	.00	
	59	151.9	67.5	TAP	.960			
	64	-152.0	-67.5					
BUS	64	.984	24.52	.0	.0	.00	.00	
	61	30.7	14.0	TAP	.985			
	63	152.5	52.5					
	65	-183.1	-66.5					
BUS	65	1.005	27.65	391.0	81.3	.00	.00	
	38	186.6	-8.8					
	64	184.1	40.1					
	66	8.8	72.3	TAP	.935			
	68	11.4	-22.2					
BUS	66	1.050	27.48	392.0	-2.0	39.00	18.00	
	49	135.3	8.3					
	49	135.3	8.3					
	62	38.0	14.7					
	65	-8.8	-70.6					
	67	53.2	19.3					
BUS	67	1.020	24.84	.0	.0	28.00	7.00	
	62	24.5	12.1					
	66	-52.5	-19.1					
BUS	68	1.003	27.55	.0	.0	.00	.00	
	65	-11.4	-42.1					
	69	-128.2	112.9	TAP	.935			
	81	-44.6	-4.6					
	116	183.9	-66.2					
BUS	69	1.035	30.00	518.5	-82.7	.00	.00	
	47	59.1	-10.1					
	49	49.2	-12.1					
	68	128.2	-103.6					
	70	108.9	16.0					
	75	110.3	20.4					
	77	62.7	6.7					
BUS	70	.984	22.58	.0	8.3	66.00	20.00	
	24	6.2	-8.3					
	69	-105.4	-13.8					
	71	17.4	-12.5					
	74	16.1	12.9					
	75	-.3	10.0					
BUS	71	.987	22.15	.0	.0	.00	.00	
	70	-17.3	11.8					
	72	11.3	-1.1					
	73	6.0	-10.7					
BUS	72	.980	20.98	-12.0	-11.1	.00	.00	
	24	-.7	-8.2					
	71	-11.2	-3.0					
BUS	73	.991	21.94	-6.0	9.7	.00	.00	
	71	-6.0	9.7					
BUS	74	.958	21.54	.0	-5.6	68.00	27.00	11.0
	70	-15.9	-15.5					
	75	-52.1	-6.1					
BUS	75	.967	22.91	.0	.0	47.00	11.00	
	69	-105.5	-18.2					

	70	.3	-13.2						
	74	52.5	6.4						
	77	-34.6	-9.6						
	118	40.2	23.6						
BUS	76	.943	21.77	.0	5.3	68.00	36.00		
	77	-61.1	-21.0						
	118	-6.9	-9.7						
BUS	77	1.006	26.72	.0	12.0	61.00	28.00		
	69	-61.5	-13.6						
	75	35.4	7.4						
	76	63.2	24.4						
	78	45.4	6.6						
	80	-96.4	-37.5						
	80	-44.3	-20.6						
	82	-3.0	17.3						
BUS	78	1.003	26.42	.0	.0	71.00	26.00		
	77	-45.4	-7.6						
	79	-25.6	-18.4						
BUS	79	1.009	26.72	.0	.0	39.00	32.00	20.37	
	78	25.7	18.0						
	80	-64.7	-29.6						
BUS	80	1.040	28.96	477.0	105.1	130.00	26.00		
	77	98.2	37.6						
	77	45.0	20.6						
	79	65.4	31.1						
	81	44.6	-73.1						
	96	18.9	20.8						
	97	26.4	25.5						
	98	28.9	8.3						
	99	19.5	8.2						
BUS	81	.997	28.10	.0	.0	.00	.00		
	68	44.7	-75.6						
	80	-44.6	75.6	TAP	.935				
BUS	82	.989	27.24	.0	.0	54.00	27.00	19.55	
	77	3.1	-25.0						
	83	-47.0	24.5						
	96	-10.1	-6.9						
BUS	83	.985	28.42	.0	.0	20.00	10.00	9.69	
	82	47.4	-27.1						
	84	-24.7	14.7						
	85	-42.7	12.1						
BUS	84	.980	30.95	.0	.0	11.00	7.00		
	83	25.3	-16.0						
	85	-36.3	9.0						
BUS	85	.985	32.51	.0	-5.8	24.00	15.00		
	83	43.6	-12.4						
	84	36.7	-9.3						
	86	17.2	-7.4						
	88	-50.3	7.6						
	89	-71.2	.7						
BUS	86	.987	31.14	.0	.0	21.00	10.00		
	85	-17.0	5.1						
	87	-4.0	-15.1						
BUS	87	1.015	31.40	4.0	11.0	.00	.00		

		86	4.0	11.0				
BUS	88	.987	35.64	.0	.0	48.00	10.00	
		85	50.8	-7.5				
		89	-98.9	-2.5				
BUS	89	1.005	39.69	607.0	-12.6	.00	.00	
		85	72.4	3.7				
		88	100.2	7.7				
		90	58.2	-4.7				
		90	110.7	-5.4				
		92	201.8	-7.2				
		92	63.6	-6.7				
BUS	90	.985	33.29	-85.0	59.3	78.00	42.00	
		89	-56.4	5.8				
		89	-107.8	7.0				
		91	1.3	4.5				
BUS	91	.980	33.31	-10.0	-15.1	.00	.00	
		90	-1.3	-6.5				
		92	-8.7	-8.6				
BUS	92	.993	33.80	.0	-3.0	65.00	10.00	
		89	-197.8	22.1				
		89	-62.0	8.9				
		91	8.8	5.6				
		93	57.7	-10.6				
		94	52.3	-14.2				
		100	31.4	-17.2				
		102	44.6	-7.6				
BUS	93	.987	30.79	.0	.0	12.00	7.00	
		92	-56.8	11.4				
		94	44.8	-18.4				
BUS	94	.991	28.64	.0	.0	30.00	16.00	
		92	-50.8	14.8				
		93	-44.3	18.3				
		95	40.9	9.4				
		96	19.9	-9.4				
		100	4.3	-49.1				
BUS	95	.981	27.67	.0	.0	42.00	31.00	
		94	-40.7	-9.7				
		96	-1.3	-21.3				
BUS	96	.993	27.51	.0	.0	38.00	15.00	
		80	-18.6	-24.4				
		82	10.1	1.7				
		94	-19.7	7.5				
		95	1.4	20.1				
		97	11.1	-19.9				
BUS	97	1.011	27.88	.0	.0	15.00	9.00	
		80	-26.2	-27.0				
		96	11.2	17.9				
BUS	98	1.024	27.40	.0	.0	34.00	8.00	
		80	-28.7	-10.4				
		100	-5.3	2.4				
BUS	99	1.010	27.04	-42.0	-17.5	.00	.00	
		80	-19.3	-13.0				
		100	-22.7	-4.6				

BUS 100	1.017	28.03	252.0	108.2	37.00	18.00		
	92	-30.7	12.9					
	94	-3.9	44.3					
	98	5.3	-7.3					
	99	22.8	2.8					
	101	-16.7	22.0					
	103	121.1	-4.3					
	104	56.4	10.6					
	106	60.6	9.2					
BUS 101	.993	29.61	.0	.0	22.00	15.00		
	100	17.0	-24.2					
	102	-39.0	9.3					
BUS 102	.991	32.30	.0	.0	5.00	3.00		
	92	-44.3	7.3					
	101	39.4	-10.3					
BUS 103	1.001	24.44	40.0	40.0	23.00	16.00		
	100	-118.9	6.3					
	104	32.3	7.9					
	105	43.0	6.5					
	110	60.6	3.2					
BUS 104	.971	21.69	.0	5.7	38.00	25.00		
	100	-55.0	-9.3					
	103	-31.8	-10.1					
	105	48.7	.1					
BUS 105	.966	20.57	.0	-8.0	31.00	26.00	18.66	
	103	-41.9	-7.4					
	104	-48.5	-.0					
	106	8.7	4.6					
	107	26.7	-1.9					
	108	24.0	-10.6					
BUS 106	.962	20.32	.0	.0	43.00	16.00		
	100	-58.3	-6.8					
	105	-8.6	-5.8					
	107	24.0	-3.4					
BUS 107	.952	17.53	-22.0	5.7	28.00	12.00	5.44	
	105	-26.3	-1.1					
	106	-23.7	.2					
BUS 108	.967	19.38	.0	.0	2.00	1.00		
	105	-23.8	3.4					
	109	21.8	-10.4					
BUS 109	.967	18.93	.0	.0	8.00	3.00		
	108	-21.7	9.9					
	110	13.7	-12.9					
BUS 110	.973	18.09	.0	4.9	39.00	30.00	5.68	
	103	-59.1	-1.0					
	109	-13.6	11.2					
	111	-35.7	1.0					
	112	69.4	-30.6					
BUS 111	.980	19.74	36.0	-1.8	.00	.00		
	110	36.0	-1.8					
BUS 112	.975	14.99	-43.0	41.5	25.00	13.00		
	110	-68.0	28.5					
BUS 113	.993	13.74	-6.0	6.4	.00	.00		

	17	-1.9	-6.8			
	32	-3.9	13.1			
BUS 114	.960	14.46	.0	.0	8.00	3.00
	32	-9.5	-3.6			
	115	.9	.7			
BUS 115	.960	14.46	.0	.0	22.00	7.00
	27	-20.6	-6.1			
	114	-.9	-1.0			
BUS 116	1.005	27.12	-184.0	51.3	.00	.00
	68	-183.7	51.2			
BUS 117	.974	10.67	.0	.0	20.00	8.00
	12	-20.0	-8.0			
BUS 118	.949	21.92	.0	.0	33.00	15.00
	75	-39.9	-23.5			
	76	6.9	8.5			
LOSSES	132.9	784.7				
SWING 69						
MISMATCH						
	.291	.003				
	.072	-.028				
	-.008	-.004				
	1.289	.008				
	-.220	.056				
	.332	.077				
	-.046	-.003				
	.198	-.047				
	.079	-.086				
	-.196	-.026				
	.352	-.103				
	-.243	.427				
	-.048	.015				
	-.044	.013				
	.366	.042				
	-.030	.005				
	.471	-.105				
	.056	.070				
	-.140	.037				
	.035	-.012				
	.010	-.009				
	-.009	-.006				
	.231	-.072				
	-.057	.060				
	.207	.012				
	-.058	-.010				
	.250	.034				
	.017	-.005				
	.148	-.055				
	-.215	.005				
	-.075	.136				
	.001	.007				
	.000	-.001				
	.825	-.245				
	.692	-.161				
	-.508	.337				
	-.316	.097				
	-.187	-.012				
	.042	-.010				
	.056	.069				
	-.040	.011				
	-.021	.031				

-.010	.002
.020	-.007
.004	-.009
.021	.011
.027	-.010
.040	-.017
.057	.067
-.005	.002
.062	-.021
-.013	.006
.010	-.003
.305	.022
.164	.017
-.184	.219
-.030	.010
-.041	.014
.072	.015
.218	-.053
.025	.063
-.039	.043
.071	-.021
-.078	-.013
.079	.007
-.072	.011
-.032	.006
.350	-.043
-2.053	82.670
.065	.010
.031	-.007
-.024	.017
-.028	.014
.018	.008
-.001	-.001
.025	.001
.148	.007
-.012	.004
-.013	.000
.057	.024
-.079	.002
.051	-.019
-.005	-.003
.013	-.008
.021	.018
-.000	.001
-.005	.002
.012	-.005
.049	.005
.005	.014
.002	.009
.023	-.004
.008	-.002
.051	-.016
.002	-.002
-.034	.010
-.021	.003
.000	-.000
.016	.003
.025	.026
.005	-.003
-.027	.005
.008	.000
.031	.010
.020	-.007
-.015	.004
-.009	.009
.034	-.013

-.015	.005
.029	.017
-.012	.009
-.011	.016
-.164	.140
.574	-.139
-.526	.106
-.258	.060
-.041	.010
-.025	.007

ITERATION COUNT	143	
TOTAL MISMATCH	4.577	1.217
AVERAGE MISMATCH	.039	.010

AEP 118 BUS TEST SYSTEM

IMPEDANCES

GROUP 1

NO CONVERSIONS

P	C	R	X	BC/2
1	2	.0303C	.09990	.01270
1	3	.0129C	.04240	.00541
4	5	.00176	.00798	.00105
3	5	.02410	.10800	.01420
5	6	.0119C	.05400	.00713
6	7	.00459	.02080	.00275
8	9	.00244	.03050	.58100
5	8	.0000C	.02670	.00000
9	10	.00258	.03220	.61500
4	11	.0209C	.06880	.00874
5	11	.0203C	.06820	.00869
11	12	.00595	.01960	.00251
2	12	.01870	.06160	.00786
3	12	.0484C	.16000	.02030
7	12	.00862	.03400	.00437
11	13	.02225	.07310	.00938
12	14	.0215C	.07070	.00908
13	15	.0744C	.24440	.03134
14	15	.0595C	.19500	.02510
12	16	.0212C	.08340	.01070
15	17	.0132C	.04370	.02220
16	17	.04540	.18010	.02330
17	18	.0123C	.05050	.00649
18	19	.0119C	.04930	.00571
19	20	.0252C	.11700	.01490
15	19	.0120C	.03940	.00505
20	21	.0183C	.08490	.01080
21	22	.0209C	.09700	.01230
22	23	.03420	.15900	.02020
23	24	.0135C	.04920	.02490
23	25	.0156C	.08000	.04320
25	26	.0000C	.03820	.00000
25	27	.0318C	.16300	.08820
27	28	.01913	.08550	.01080
28	29	.0237C	.09430	.01190
17	30	.0000C	.03880	.00000
8	30	.00431	.05040	.25700
26	30	.00799	.08600	.45400
17	31	.0474C	.15630	.01995
29	31	.0108C	.03310	.00415
23	32	.0317C	.11530	.05865
31	32	.0298C	.09850	.01255
27	32	.0229C	.07550	.00963
15	33	.0380C	.12440	.01597
19	34	.07520	.24700	.03160
35	36	.00224	.01020	.00134
35	37	.0110C	.04970	.00659
33	37	.0415C	.14200	.01830
34	36	.00871	.02680	.00284
34	37	.00256	.00940	.00492
37	38	.00000	.03750	.00000
37	39	.03210	.10600	.01350
37	40	.05930	.16800	.02100
30	38	.00464	.05400	.21100
39	40	.0184C	.06050	.00776

40	41	.01450	.04780	.00611
40	42	.05550	.18300	.02330
41	42	.04100	.13500	.01720
43	44	.06080	.24540	.03034
34	43	.04130	.16810	.02113
44	45	.02240	.09010	.01120
45	46	.04000	.13560	.01660
46	47	.03800	.12700	.01580
46	48	.06010	.18900	.02360
47	49	.01910	.06250	.00802
42	49	.07150	.32300	.04300
42	49	.07150	.32300	.04300
45	49	.06840	.18600	.02220
48	49	.01790	.05050	.00629
49	50	.02670	.07520	.00937
49	51	.04860	.13700	.01710
51	52	.02030	.05880	.00698
52	53	.04050	.16350	.02029
53	54	.02630	.12200	.01550
49	54	.07300	.28900	.03690
49	54	.08690	.29100	.03650
54	55	.01690	.07070	.01010
54	56	.00275	.00955	.00366
55	56	.00488	.01510	.00187
56	57	.03430	.09660	.01210
50	57	.04740	.13400	.01660
56	58	.03430	.09660	.01210
51	58	.02550	.07190	.00894
54	59	.05030	.22930	.02990
56	59	.08250	.25100	.02845
56	59	.08030	.23900	.02680
55	59	.04739	.21580	.02823
59	60	.03170	.14500	.01880
59	61	.03280	.15000	.01940
60	61	.00264	.01350	.00728
60	62	.01230	.05610	.00734
61	62	.00824	.03760	.00490
59	63	.00000	.03860	.00000
63	64	.00172	.02000	.10800
61	64	.00000	.02680	.00000
38	65	.00901	.09860	.52300
64	65	.00269	.03020	.19000
49	66	.01800	.09190	.01240
49	66	.01800	.09190	.01240
62	66	.04820	.21800	.02890
62	67	.02580	.11700	.01550
65	56	.00000	.03700	.00000
66	67	.02240	.10150	.01341
65	68	.00138	.01600	.31900
47	69	.08440	.27780	.03546
49	69	.09850	.32400	.04140
68	69	.00000	.03700	.00000
69	70	.03000	.12700	.06100
24	70	.10221	.41150	.05099
70	71	.00882	.03550	.00439
24	72	.04880	.13600	.02440
71	72	.04460	.18300	.02220
71	73	.00866	.04540	.00589
70	74	.04010	.13230	.01684
70	75	.04280	.14100	.01800
69	75	.04050	.12200	.06200
74	75	.01230	.04060	.00517
76	77	.04440	.14800	.01840
69	77	.03090	.10100	.05190
75	77	.06010	.19990	.02489
77	78	.00376	.01240	.00632

78	79	.00546	.02440	.00324
77	80	.01700	.04850	.02360
77	80	.02940	.10500	.01140
79	80	.01560	.07040	.00935
68	81	.00175	.02020	.40400
80	81	.00000	.03700	.00000
77	82	.02980	.08530	.04087
82	83	.01120	.03665	.01898
83	84	.06250	.13200	.01290
83	85	.04300	.14800	.01740
84	85	.03020	.06410	.00617
85	86	.03500	.12300	.01380
86	87	.02828	.20740	.02225
85	88	.02000	.10200	.01380
85	89	.02390	.17300	.02350
88	89	.01390	.07120	.00967
89	90	.05180	.18800	.02640
89	90	.02380	.09970	.05300
90	91	.02540	.08360	.01070
89	92	.00990	.05050	.02740
89	92	.03930	.15810	.02070
91	92	.03870	.12720	.01634
92	93	.02580	.08480	.01090
92	94	.04810	.15800	.02030
93	94	.02230	.07320	.00938
94	95	.01320	.04340	.00555
80	96	.03560	.18200	.02470
82	96	.01620	.05300	.02720
94	96	.02690	.08690	.01150
80	97	.01830	.09340	.01270
80	98	.02380	.10800	.01430
80	99	.04540	.20600	.02730
92	100	.06480	.29500	.03860
94	100	.01780	.05800	.03020
95	96	.01710	.05470	.00737
96	97	.01730	.08850	.01200
98	100	.03970	.17900	.02380
99	100	.01800	.08130	.01080
100	101	.02770	.12620	.01640
92	102	.01230	.05590	.00732
101	102	.02460	.11200	.01470
100	103	.01600	.05250	.02680
100	104	.04510	.20400	.02705
103	104	.04660	.15840	.02035
103	105	.05350	.16250	.02040
100	106	.06050	.22900	.03100
104	105	.00994	.03780	.00493
105	106	.01400	.05470	.00717
105	107	.05300	.18300	.02360
105	108	.02610	.07030	.00922
106	107	.05300	.18300	.02360
108	109	.01050	.02880	.00380
103	110	.03906	.18130	.02305
109	110	.02780	.07030	.01010
110	111	.02200	.07550	.01000
110	112	.02470	.06400	.03100
17	113	.00913	.03010	.00384
32	113	.06150	.20300	.02590
32	114	.01350	.06120	.00814
27	115	.01640	.07410	.00986
114	115	.00230	.01040	.00138
68	116	.00034	.00405	.00200
12	117	.03290	.14000	.01790
75	118	.01450	.04810	.00599
76	118	.01640	.05440	.00678

ADMITTANCES (100 MVA BASE)

P	Q	G	B	BC/2
1	2	2.78030	9.16674	.01270
1	3	6.56766	21.58673	.00541
2	1	2.78030	9.16674	.01270
2	12	4.51228	14.86397	.00786
3	1	6.56766	21.58673	.00541
3	5	1.96818	8.82006	.01420
3	12	1.73212	5.72603	.02030
4	5	26.35599	119.50043	.00105
4	11	4.04236	13.30690	.00874
5	3	1.96818	8.82006	.01420
5	4	26.35599	119.50043	.00105
5	6	3.89193	17.66085	.00713
5	8	.00000	37.45318	.00000
5	11	4.00922	13.46940	.00869
6	5	3.89193	17.66085	.00713
6	7	10.11664	45.84445	.00275
7	6	10.11664	45.84445	.00275
7	12	7.00640	27.63544	.00437
8	5	.00000	37.45318	.00000
8	9	2.60627	32.57838	.58100
8	30	1.68443	19.69723	.25700
9	8	2.60627	32.57838	.58100
9	10	2.47246	30.85780	.61500
10	9	2.47246	30.85780	.61500
11	4	4.04236	13.30690	.00874
11	5	4.00922	13.46940	.00869
11	12	14.18144	46.71533	.00251
11	13	3.81080	12.51997	.00938
12	2	4.51228	14.86397	.00786
12	3	1.73212	5.72603	.02030
12	7	7.00640	27.63544	.00437
12	11	14.18144	46.71533	.00251
12	14	3.93720	12.94696	.00908
12	16	2.86293	11.26266	.01070
12	117	1.59072	6.76904	.01790
13	11	3.81080	12.51997	.00938
13	15	1.13994	3.74463	.03134
14	12	3.93720	12.94696	.00908
14	15	1.43148	4.69142	.02510
15	13	1.13994	3.74463	.03134
15	14	1.43148	4.69142	.02510
15	17	6.33419	20.96999	.02220
15	19	7.07397	23.22620	.00505
15	33	2.24595	7.35252	.01597
16	12	2.86293	11.26266	.01070
16	17	1.31605	5.22072	.02330
17	15	6.33419	20.96999	.02220
17	16	1.31605	5.22072	.02330
17	18	4.55296	18.69304	.00649
17	30	.00000	25.77320	.00000
17	31	1.77685	5.85910	.01995
17	113	9.22812	30.42350	.00384
18	17	4.55296	18.69304	.00649
18	19	4.62657	19.16722	.00571
19	15	7.07397	23.22620	.00505
19	18	4.62657	19.16722	.00571
19	20	1.75928	8.16809	.01490
19	34	1.12804	3.70515	.03160
20	19	1.75928	8.16809	.01490
20	21	2.42612	11.25562	.01080
21	20	2.42612	11.25562	.01080
21	22	2.12273	9.85191	.01230
22	21	2.12273	9.85191	.01230

22	23	1.29297	6.01120	.02020
23	22	1.29297	6.01120	.02020
23	24	5.18654	18.90207	.02490
23	25	2.34821	12.04210	.04320
23	32	2.21694	8.06351	.05865
24	23	5.18654	18.90207	.02490
24	70	.56853	2.28892	.05099
24	72	1.19615	4.80422	.02440
25	23	2.34821	12.04210	.04320
25	26	.00000	26.17801	.00000
25	27	1.15300	5.91003	.08820
26	25	.00000	26.17801	.00000
26	30	1.07107	11.52840	.45400
27	25	1.15300	5.91003	.08820
27	28	2.49212	11.13831	.01080
27	32	3.67892	12.12918	.00963
27	115	2.84734	12.86510	.00986
28	27	2.49212	11.13831	.01080
28	29	2.50683	9.97442	.01190
29	28	2.50683	9.97442	.01190
29	31	8.90905	27.30460	.00415
30	8	1.68443	19.69723	.25700
30	17	.00000	25.77320	.00000
30	26	1.07107	11.52840	.45400
30	38	1.57956	18.38279	.21100
31	17	1.77685	5.85910	.01995
31	29	8.90905	27.30460	.00415
31	32	2.81390	9.30097	.01255
32	23	2.21694	8.06351	.05865
32	27	3.67892	12.12918	.00963
32	31	2.81390	9.30097	.01255
32	113	1.36693	4.51199	.02590
32	114	3.43713	15.58168	.00814
33	15	2.24595	7.35252	.01597
33	37	1.89617	6.48809	.01830
34	19	1.12804	3.70515	.03160
34	36	10.96834	33.74872	.00284
34	37	26.97190	99.03744	.00492
34	43	1.37835	5.61020	.02113
35	36	20.53960	93.52856	.00134
35	37	4.24532	19.18112	.00659
36	34	10.96834	33.74872	.00284
36	35	20.53960	93.52856	.00134
37	33	1.89617	6.48809	.01830
37	34	26.97190	99.03744	.00492
37	35	4.24532	19.18112	.00659
37	38	.00000	26.66667	.00000
37	39	2.61690	8.64149	.01350
37	40	1.86828	5.29292	.02100
38	30	1.57956	18.38279	.21100
38	37	.00000	26.66667	.00000
38	65	.91909	10.05800	.52300
39	37	2.61690	8.64149	.01350
39	40	4.60137	15.12950	.00776
40	37	1.86828	5.29292	.02100
40	39	4.60137	15.12950	.00776
40	41	5.81141	19.15763	.00611
40	42	1.51767	5.00420	.02330
41	40	5.81141	19.15763	.00611
41	42	2.05968	6.78187	.01720
42	40	1.51767	5.00420	.02330
42	41	2.05968	6.78187	.01720
42	49	.65332	2.95136	.04300
42	49	.65332	2.95136	.04300
43	34	1.37835	5.61020	.02113
43	44	.95122	3.83931	.03034

44	43	.95122	3.83931	.03034
44	45	2.59868	10.45272	.01120
45	44	2.59868	10.45272	.01120
45	46	2.00126	6.78429	.01660
45	49	1.74159	4.73589	.02220
46	45	2.00126	6.78429	.01660
46	47	2.16241	7.22700	.01580
46	48	1.52798	4.80512	.02360
47	46	2.16241	7.22700	.01580
47	49	4.47196	14.63337	.00802
47	69	1.00123	3.29552	.03546
48	46	1.52798	4.80512	.02360
48	49	6.23550	17.59177	.00629
49	42	.65332	2.95136	.04300
49	42	.65332	2.95136	.04300
49	45	1.74159	4.73589	.02220
49	47	4.47196	14.63337	.00802
49	48	6.23550	17.59177	.00629
49	50	4.19289	11.80918	.00937
49	51	2.29994	6.48338	.01710
49	54	.82161	3.25267	.03690
49	54	.94218	3.15507	.03650
49	66	2.05254	10.47937	.01240
49	66	2.05254	10.47937	.01240
49	69	.85892	2.82530	.04140
50	49	4.19289	11.80918	.00937
50	57	2.34621	6.63276	.01660
51	49	2.29994	6.48338	.01710
51	52	5.24612	15.19564	.00698
51	58	4.38155	12.35425	.00894
52	51	5.24612	15.19564	.00698
52	53	1.42744	5.76262	.02029
53	52	1.42744	5.76262	.02029
53	54	1.68853	7.83272	.01550
54	49	.82161	3.25267	.03690
54	49	.94218	3.15507	.03650
54	53	1.68853	7.83272	.01550
54	55	3.19827	13.37976	.01010
54	56	27.84387	96.69417	.00366
54	59	.91274	4.16088	.02990
55	54	3.19827	13.37976	.01010
55	56	19.37858	59.96242	.00187
55	59	.97080	4.42073	.02823
56	54	27.84387	96.69417	.00366
56	55	19.37858	59.96242	.00187
56	57	3.26416	9.19295	.01210
56	58	3.26416	9.19295	.01210
56	59	1.18183	3.59562	.02845
56	59	1.26319	3.75969	.02680
57	50	2.34621	6.63276	.01660
57	56	3.26416	9.19295	.01210
58	51	4.38155	12.35425	.00894
58	56	3.26416	9.19295	.01210
59	54	.91274	4.16088	.02990
59	55	.97080	4.42073	.02823
59	56	1.18183	3.59562	.02845
59	56	1.26319	3.75969	.02680
59	60	1.43895	6.58197	.01880
59	61	1.39125	6.36245	.01940
59	63	.00000	25.90674	.00000
60	59	1.43895	6.58197	.01080
60	61	13.95204	71.34567	.00728
60	62	3.72897	17.00773	.00734
61	59	1.39125	6.36245	.01940
61	60	13.95204	71.34567	.00728
61	62	5.56134	25.37698	.00490

61	64	.00000	37.31343	.00000
62	60	3.72897	17.00773	.00734
62	61	5.56134	25.37698	.00490
62	66	.96695	4.37336	.02890
62	67	1.79733	8.15067	.01550
63	59	.00000	25.90674	.00000
63	64	4.26843	49.63292	.10800
64	61	.00000	37.31343	.00000
64	63	4.26843	49.63292	.10800
64	65	2.92622	32.85194	.19000
65	38	.91909	10.05800	.52300
65	64	2.92622	32.85194	.19000
65	66	.00000	27.02703	.00000
65	68	5.35082	62.03849	.31900
66	49	2.05254	10.47937	.01240
66	49	2.05254	10.47937	.01240
66	62	.96695	4.37336	.02890
66	65	.00000	27.02703	.00000
66	67	2.07330	9.39466	.01341
67	62	1.79733	8.15067	.01550
67	66	2.07330	9.39466	.01341
68	65	5.35082	62.03849	.31900
68	69	.00000	27.02703	.00000
68	81	4.25685	49.13616	.40400
68	116	20.58348	245.18559	.08200
69	47	1.00123	3.29552	.03546
69	49	.85892	2.82530	.04140
69	68	.00000	27.02703	.00000
69	70	1.76170	7.45787	.06100
69	75	2.45094	7.38309	.06200
69	77	2.76986	9.05358	.05190
70	24	.56853	2.28892	.05099
70	69	1.76170	7.45787	.06100
70	71	6.59172	26.53130	.00439
70	74	2.09824	6.92261	.01684
70	75	1.97118	6.49385	.01800
71	70	6.59172	26.53130	.00439
71	72	1.29692	5.23421	.02220
71	73	4.05401	21.25313	.00589
72	24	1.19615	4.80422	.02440
72	71	1.29692	5.23421	.02220
73	71	4.05401	21.25313	.00589
74	70	2.09824	6.92261	.01684
74	75	6.83466	22.55994	.00517
75	69	2.45094	7.38309	.06200
75	70	1.97118	6.49385	.01800
75	74	6.83466	22.55994	.00517
75	77	1.37933	4.58781	.02489
75	118	5.74517	19.05811	.00599
76	77	1.85966	6.19886	.01840
76	118	5.08004	16.85087	.00678
77	69	2.76986	9.05358	.05190
77	75	1.37933	4.58781	.02489
77	76	1.85966	6.19886	.01840
77	78	22.39460	73.85454	.00632
77	80	6.43635	18.36252	.02360
77	80	2.47280	8.83143	.01140
77	82	3.65011	10.44814	.04087
78	77	22.39460	73.85454	.00632
78	79	8.73360	39.02928	.00324
79	78	8.73360	39.02928	.00324
79	80	3.00028	13.53971	.00935
80	77	6.43635	18.36252	.02360
80	77	2.47280	8.83143	.01140
80	79	3.00028	13.53971	.00935
80	81	.00000	27.02703	.00000

80	96	1.03514	5.29203	.02470
80	97	2.02021	10.31081	.01270
80	98	1.94596	8.83043	.01430
80	99	1.02029	4.62951	.02730
81	68	4.25685	49.13616	.40400
81	80	.00000	27.02703	.00000
82	77	3.65011	10.44814	.04087
82	83	7.62599	24.95468	.01898
82	96	5.27440	17.25575	.02720
83	82	7.62599	24.95468	.01898
83	84	2.93011	6.18839	.01290
83	85	1.81030	6.23079	.01740
84	83	2.93011	6.18839	.01290
84	85	6.01492	12.76676	.00617
85	83	1.81030	6.23079	.01740
85	84	6.01492	12.76676	.00617
85	86	2.14015	7.52110	.01380
85	88	1.85117	9.44095	.01380
85	89	.78360	5.67209	.02350
86	85	2.14015	7.52110	.01380
86	87	.64545	4.73359	.02225
87	86	.64545	4.73359	.02225
88	85	1.85117	9.44095	.01380
88	89	2.64125	13.52931	.00967
89	85	.78360	5.67209	.02350
89	88	2.64125	13.52931	.00967
89	90	1.36218	4.94382	.02640
89	90	2.26526	9.48934	.05300
89	92	3.73830	19.06912	.02740
89	92	1.48078	5.95702	.02070
90	89	1.36218	4.94382	.02640
90	89	2.26526	9.48934	.05300
90	91	3.32717	10.95084	.01070
91	90	3.32717	10.95084	.01070
91	92	2.18922	7.19558	.01634
92	89	3.73830	19.06912	.02740
92	89	1.48078	5.95702	.02070
92	91	2.18922	7.19558	.01634
92	93	3.28383	10.79336	.01090
92	94	1.76335	5.79230	.02030
92	100	.71034	3.23380	.03860
92	102	3.75446	17.06297	.00732
93	92	3.28383	10.79336	.01090
93	94	3.80837	12.50100	.00938
94	92	1.76335	5.79230	.02030
94	93	3.80837	12.50100	.00938
94	95	6.41462	21.09049	.00555
94	96	3.25067	10.50123	.01150
94	100	4.83585	15.75727	.03020
95	94	6.41462	21.09049	.00555
95	96	5.20627	16.65398	.00737
96	80	1.03514	5.29203	.02470
96	82	5.27440	17.25575	.02720
96	94	3.25067	10.50123	.01150
96	95	5.20627	16.65398	.00737
96	97	2.12752	10.88355	.01200
97	80	2.02021	10.31081	.01270
97	96	2.12752	10.88355	.01200
98	80	1.94596	8.83043	.01430
98	100	1.18095	5.32467	.02380
99	80	1.02029	4.62951	.02730
99	100	2.59602	11.72536	.01080
100	92	.71034	3.23380	.03860
100	94	4.83585	15.75727	.03020
100	98	1.18095	5.32467	.02380
100	99	2.59602	11.72536	.01080

100	101	1.65931	7.55972	.01640
100	103	5.31164	17.42883	.02680
100	104	1.03322	4.67354	.02705
100	106	1.07841	4.08191	.03100
101	100	1.65931	7.55972	.01640
101	102	1.87084	8.51765	.01470
102	92	3.75446	17.06297	.00732
102	101	1.87084	8.51765	.01470
103	100	5.31164	17.42883	.02680
103	104	1.70933	5.81026	.02035
103	105	1.82790	5.55204	.02040
103	110	1.13562	5.27106	.02305
104	100	1.03322	4.67354	.02705
104	103	1.70933	5.81026	.02035
104	105	6.50675	24.74399	.00493
105	103	1.82790	5.55204	.02040
105	104	6.50675	24.74399	.00493
105	106	4.39134	17.15761	.00717
105	107	1.46014	5.04160	.02360
105	108	4.64140	12.50156	.00922
106	100	1.07841	4.08191	.03100
106	105	4.39134	17.15761	.00717
106	107	1.46014	5.04160	.02360
107	105	1.46014	5.04160	.02360
107	106	1.46014	5.04160	.02360
108	105	4.64140	12.50156	.00922
108	109	11.17390	30.64841	.00380
109	108	11.17390	30.64841	.00380
109	110	4.22539	11.58181	.01010
110	103	1.13562	5.27106	.02305
110	109	4.22539	11.58181	.01010
110	111	3.55742	12.20843	.01000
110	112	5.24852	13.59940	.03100
111	110	3.55742	12.20843	.01000
112	110	5.24852	13.59940	.03100
113	17	9.22812	30.42350	.00384
113	32	1.36693	4.51199	.02590
114	32	3.43713	15.58168	.00814
114	115	20.27325	91.67034	.00138
115	27	2.84734	12.86510	.00986
115	114	20.27325	91.67034	.00138
116	68	20.58348	245.18559	.08200
117	12	1.59072	6.76904	.01790
118	75	5.74517	19.05811	.00599
118	76	5.08004	16.85087	.00678

THESE ADMITTANCES WRITTEN IN BINARY ON TAPE NO. 1
AS RECORD NO. 1

Appendix D

IEEE 118 Bus Network

FDLF Based Results

D.1. Transmission line data
Transformer data
Shunt element data

D.2. Bus oriented results

D.3. Line flow results

Sbase: 100.

Transmission Lines

NO	NE	R %	X %	X/R	wC*Sbase	Length
BUS 1	BUS 2	3.030	9.990	3.30	2.540	48.0
BUS 1	BUS 3	1.290	4.240	3.29	1.082	20.4
BUS 4	BUS 5	.176	.798	4.53	.210	3.2
BUS 3	BUS 5	2.410	10.800	4.48	2.840	43.7
BUS 5	BUS 6	1.190	5.400	4.54	1.426	21.7
BUS 6	BUS 7	.459	2.080	4.53	.550	8.4
BUS 8	BUS 9	.244	3.050	12.50	116.200	90.5
BUS 9	BUS 10	.258	3.220	12.48	123.000	95.6
BUS 4	BUS 11	2.090	6.880	3.29	1.748	33.1
BUS 5	BUS 11	2.030	6.820	3.36	1.738	32.4
BUS 11	BUS 12	.595	1.960	3.29	.502	9.4
BUS 2	BUS 12	1.870	6.160	3.29	1.572	29.6
BUS 3	BUS 12	4.840	16.000	3.31	4.060	76.8
BUS 7	BUS 12	.862	3.400	3.94	.874	14.7
BUS 11	BUS 13	2.225	7.310	3.29	1.876	35.2
BUS 12	BUS 14	2.150	7.070	3.29	1.816	34.0
BUS 13	BUS 15	7.440	24.440	3.28	6.268	117.8
BUS 14	BUS 15	5.950	19.500	3.28	5.020	94.1
BUS 12	BUS 16	2.120	8.340	3.93	2.140	36.2
BUS 15	BUS 17	1.320	4.370	3.31	4.440	21.0
BUS 16	BUS 17	4.540	18.010	3.97	4.660	77.9
BUS 17	BUS 18	1.230	5.050	4.11	1.298	21.4
BUS 18	BUS 19	1.190	4.930	4.14	1.142	20.8
BUS 19	BUS 20	2.520	11.700	4.64	2.980	46.5
BUS 15	BUS 19	1.200	3.940	3.28	1.010	19.0
BUS 20	BUS 21	1.830	8.490	4.64	2.160	33.8
BUS 21	BUS 22	2.090	9.700	4.64	2.460	38.6
BUS 22	BUS 23	3.420	15.900	4.65	4.040	63.2
BUS 23	BUS 24	1.350	4.920	3.64	4.980	22.3
BUS 23	BUS 25	1.560	8.000	5.13	8.640	30.3
BUS 25	BUS 27	3.180	16.300	5.13	17.640	61.7
BUS 27	BUS 28	1.913	8.550	4.47	2.160	34.7
BUS 28	BUS 29	2.370	9.430	3.98	2.380	40.7
BUS 8	BUS 30	.431	5.040	11.69	51.400	154.3
BUS 26	BUS 30	.799	8.600	10.76	90.800	274.2
BUS 17	BUS 31	4.740	15.630	3.30	3.990	75.2
BUS 29	BUS 31	1.080	3.310	3.06	.830	16.6
BUS 23	BUS 32	3.170	11.530	3.64	11.730	52.3
BUS 31	BUS 32	2.980	9.850	3.31	2.510	47.3
BUS 27	BUS 32	2.290	7.550	3.30	1.926	36.3
BUS 15	BUS 33	3.800	12.440	3.27	3.194	60.1
BUS 19	BUS 34	7.520	24.700	3.28	6.320	119.0
BUS 35	BUS 36	.224	1.020	4.55	.268	4.1
BUS 35	BUS 37	1.100	4.970	4.52	1.318	20.0
BUS 33	BUS 37	4.150	14.200	3.42	3.660	66.8
BUS 34	BUS 36	.871	2.680	3.08	.568	13.4
BUS 34	BUS 37	.256	.940	3.67	.984	4.2
BUS 37	BUS 39	3.210	10.600	3.30	2.700	50.9
BUS 37	BUS 40	5.930	16.800	2.83	4.200	88.7
BUS 30	BUS 38	.464	5.400	11.64	42.200	165.7
BUS 39	BUS 40	1.840	6.050	3.29	1.552	29.1

NO	NE	R %	X %	X/R	wC*Sbase	Length
BUS 40	BUS 41	1.450	4.780	3.30	1.222	23.0
BUS 40	BUS 42	5.550	18.300	3.30	4.660	88.0
BUS 41	BUS 42	4.100	13.500	3.29	3.440	65.0
BUS 43	BUS 44	6.080	24.540	4.04	6.068	105.1
BUS 34	BUS 43	4.130	16.810	4.07	4.226	71.7
BUS 44	BUS 45	2.240	9.010	4.02	2.240	38.7
BUS 45	BUS 46	4.000	13.560	3.39	3.320	64.1
BUS 46	BUS 47	3.800	12.700	3.34	3.160	60.6
BUS 46	BUS 48	6.010	18.900	3.14	4.720	93.5
BUS 47	BUS 49	1.910	6.250	3.27	1.604	30.2
BUS 42	BUS 49	7.150	32.300	4.52	8.600	130.3
BUS 42	BUS 49	7.150	32.300	4.52	8.600	130.3
BUS 45	BUS 49	6.840	18.600	2.72	4.440	100.8
BUS 48	BUS 49	1.790	5.050	2.82	1.258	26.7
BUS 49	BUS 50	2.670	7.520	2.82	1.874	39.8
BUS 49	BUS 51	4.860	13.700	2.82	3.420	72.5
BUS 51	BUS 52	2.030	5.880	2.90	1.396	30.6
BUS 52	BUS 53	4.050	16.350	4.04	4.060	70.0
BUS 53	BUS 54	2.630	12.200	4.64	2.100	48.5
BUS 49	BUS 54	7.300	28.900	3.96	7.380	125.1
BUS 49	BUS 54	8.690	29.100	3.35	7.300	138.6
BUS 54	BUS 55	1.690	7.070	4.18	2.020	29.7
BUS 54	BUS 56	.275	.955	3.47	.732	4.5
BUS 55	BUS 56	.488	1.510	3.09	.374	7.5
BUS 56	BUS 57	3.430	9.660	2.82	2.420	51.2
BUS 50	BUS 57	4.740	13.400	2.83	3.320	70.8
BUS 56	BUS 58	3.430	9.660	2.82	2.420	51.2
BUS 51	BUS 58	2.550	7.190	2.82	1.788	38.1
BUS 54	BUS 59	5.030	22.930	4.56	5.980	92.0
BUS 56	BUS 59	8.250	25.100	3.04	5.690	126.7
BUS 56	BUS 59	8.030	23.900	2.98	5.360	122.3
BUS 55	BUS 59	4.739	21.580	4.55	5.646	86.7
BUS 59	BUS 60	3.170	14.500	4.57	3.760	58.1
BUS 59	BUS 61	3.280	15.000	4.57	3.880	60.1
BUS 60	BUS 61	.264	1.350	5.11	1.456	5.1
BUS 60	BUS 62	1.230	5.610	4.56	1.468	22.5
BUS 61	BUS 62	.824	3.760	4.56	.980	15.1
BUS 63	BUS 64	.172	2.000	11.63	21.600	61.4
BUS 38	BUS 65	.901	9.860	10.94	104.600	311.8
BUS 64	BUS 65	.269	3.020	11.23	38.000	94.3
BUS 49	BUS 66	1.800	9.190	5.11	2.480	34.8
BUS 49	BUS 66	1.800	9.190	5.11	2.480	34.8
BUS 62	BUS 66	4.820	21.800	4.52	5.980	87.9
BUS 62	BUS 67	2.580	11.700	4.53	3.100	47.1
BUS 66	BUS 67	2.240	10.150	4.53	2.682	40.9
BUS 65	BUS 68	.138	1.600	11.59	63.800	49.2
BUS 47	BUS 69	8.440	27.780	3.29	7.092	133.7
BUS 49	BUS 69	9.850	32.400	3.29	8.280	156.0
BUS 69	BUS 70	3.000	12.700	4.23	12.200	53.0
BUS 24	BUS 70	10.221	41.150	4.03	10.200	176.5
BUS 70	BUS 71	.882	3.550	4.02	.880	15.2
BUS 24	BUS 72	4.880	19.600	4.02	4.880	84.2

NO	NE	R %	X %	X/R	wC*Sbase	Length
BUS 71	BUS 72	4.460	18.000	4.04	4.444	77.1
BUS 71	BUS 73	.866	4.540	5.24	1.180	17.0
BUS 70	BUS 74	4.010	13.230	3.30	3.368	63.6
BUS 70	BUS 75	4.280	14.100	3.29	3.600	67.8
BUS 69	BUS 75	4.050	12.200	3.01	12.400	62.0
BUS 74	BUS 75	1.230	4.060	3.30	1.034	19.5
BUS 76	BUS 77	4.440	14.800	3.33	3.680	70.7
BUS 69	BUS 77	3.090	10.100	3.27	10.400	48.8
BUS 75	BUS 77	6.010	19.990	3.33	5.000	95.6
BUS 77	BUS 78	.376	1.240	3.30	1.264	6.0
BUS 78	BUS 79	.546	2.440	4.47	.648	9.9
BUS 77	BUS 80	1.700	4.850	2.85	4.720	25.5
BUS 77	BUS 80	2.940	10.500	3.57	2.280	48.2
BUS 79	BUS 80	1.560	7.040	4.51	1.870	28.4
BUS 68	BUS 81	.175	2.020	11.54	80.800	62.2
BUS 77	BUS 82	2.980	8.530	2.86	8.180	44.7
BUS 82	BUS 83	1.120	3.665	3.27	3.800	17.7
BUS 83	BUS 84	6.250	13.200	2.11	2.600	8.2
BUS 83	BUS 85	4.300	14.800	3.44	3.480	69.4
BUS 84	BUS 85	3.020	6.410	2.12	1.234	4.0
BUS 85	BUS 86	3.500	12.300	3.51	2.760	57.0
BUS 86	BUS 87	2.828	20.740	7.33	4.450	201.5
BUS 85	BUS 88	2.000	10.200	5.10	2.760	38.7
BUS 85	BUS 89	2.390	17.300	7.24	4.700	169.1
BUS 88	BUS 89	1.390	7.120	5.12	1.934	27.0
BUS 89	BUS 90	5.180	18.800	3.63	5.280	85.5
BUS 89	BUS 90	2.380	9.970	4.19	10.600	41.8
BUS 90	BUS 91	2.540	8.360	3.29	2.140	40.2
BUS 89	BUS 92	.990	5.050	5.10	5.480	19.2
BUS 89	BUS 92	3.930	15.810	4.02	4.140	67.8
BUS 91	BUS 92	3.870	12.720	3.29	3.268	61.3
BUS 92	BUS 93	2.580	8.480	3.29	2.180	40.9
BUS 92	BUS 94	4.810	15.800	3.28	4.060	76.1
BUS 93	BUS 94	2.230	7.320	3.28	1.876	35.3
BUS 94	BUS 95	1.320	4.340	3.29	1.110	20.9
BUS 80	BUS 96	3.560	18.200	5.11	4.940	69.0
BUS 82	BUS 96	1.620	5.300	3.27	5.440	25.6
BUS 94	BUS 96	2.690	8.690	3.23	2.300	42.3
BUS 80	BUS 97	1.830	9.340	5.10	2.540	35.4
BUS 80	BUS 98	2.380	10.800	4.54	2.860	43.5
BUS 80	BUS 99	4.540	20.600	4.54	5.460	82.9
BUS 92	BUS 100	6.480	29.500	4.55	7.720	118.5
BUS 94	BUS 100	1.780	5.800	3.26	6.040	28.1
BUS 95	BUS 96	1.710	5.470	3.20	1.474	26.8
BUS 96	BUS 97	1.730	8.850	5.12	2.400	33.5
BUS 98	BUS 100	3.970	17.900	4.51	4.760	72.3
BUS 99	BUS 100	1.800	8.130	4.52	2.160	32.8
BUS 100	BUS 101	2.770	12.620	4.56	3.280	50.7
BUS 92	BUS 102	1.230	5.590	4.54	1.464	22.5
BUS 101	BUS 102	2.460	11.200	4.55	2.940	45.0
BUS 100	BUS 103	1.600	5.250	3.28	5.360	25.3
BUS 100	BUS 104	4.510	20.400	4.52	5.510	82.2

NO	NE	R %	X %	X/R	wC*Sbase	Length
BUS 103	BUS 104	4.660	15.840	3.40	4.070	74.8
BUS 103	BUS 105	5.350	16.250	3.04	4.080	82.1
BUS 100	BUS 106	6.050	22.900	3.79	6.200	101.6
BUS 104	BUS 105	.994	3.780	3.80	.986	16.7
BUS 105	BUS 106	1.400	5.470	3.91	1.434	23.9
BUS 105	BUS 107	5.300	18.300	3.45	4.720	85.6
BUS 105	BUS 108	2.610	7.030	2.69	1.844	38.3
BUS 106	BUS 107	5.300	18.300	3.45	4.720	85.6
BUS 108	BUS 109	1.050	2.880	2.74	.760	15.5
BUS 103	BUS 110	3.906	18.130	4.64	4.710	72.1
BUS 109	BUS 110	2.780	7.620	2.74	2.020	41.1
BUS 110	BUS 111	2.200	7.550	3.43	2.000	35.5
BUS 110	BUS 112	2.470	6.400	2.59	6.200	35.8
BUS 17	BUS 113	.913	3.010	3.30	.768	14.5
BUS 32	BUS 113	6.150	20.300	3.30	5.180	97.5
BUS 32	BUS 114	1.350	6.120	4.53	1.626	24.6
BUS 27	BUS 115	1.640	7.410	4.52	1.972	29.9
BUS 114	BUS 115	.230	1.040	4.52	.276	4.2
BUS 68	BUS 116	.034	.405	11.91	16.400	12.3
BUS 12	BUS 117	3.290	14.000	4.26	3.580	58.3
BUS 75	BUS 118	1.450	4.810	3.32	1.200	23.0
BUS 76	BUS 118	1.640	5.440	3.32	1.356	26.1

Shunt Elements

NO	wC*Sbase
BUS 5	-40.000
BUS 17	.000
BUS 34	14.000
BUS 37	-25.000
BUS 44	10.000
BUS 45	10.000
BUS 46	10.000
BUS 48	15.000
BUS 74	12.000
BUS 79	20.000
BUS 82	20.000
BUS 83	10.000
BUS 105	20.000
BUS 107	6.000
BUS 110	6.000

Time for input: 1.18
Time for compact: .07
Time for factorization: .07
No. of iterations: 9
Maximum mismatch (in pu): 5.6E-04 7.7E-04
Time for solution: .10
Execution time: 1.42

S base : 100.

Bus	Vsp	Voltage		Generation		QGmin	QGmax	Load	
BUS 69		1.035	30.00	513.52	-82.38				
BUS 1	.955	.955	10.95	.00	-3.10	-5.00	15.00	51.00	27.00
BUS 4	.998	.998	15.56	-9.00	-15.01	-300.00	300.00	30.00	12.00
BUS 6	.990	.990	13.27	.00	15.93	-13.00	50.00	52.00	22.00
BUS 8	1.015	1.015	21.02	-28.00	62.75	-300.00	300.00	.00	.00
BUS 10	1.050	1.050	35.86	450.00	-51.04	-147.00	200.00	.00	.00
BUS 12	.990	.990	12.47	85.00	91.27	-35.00	120.00	47.00	10.00
BUS 15	.970	.970	11.46	.00	3.19	-10.00	30.00	90.00	30.00
BUS 18	.973	.973	11.76	.00	25.36	-16.00	50.00	60.00	34.00
BUS 19	.962	.963+	11.28	.00	-8.00	-8.00	24.00	45.00	25.00
BUS 24	.992	.992	21.06	-13.00	-13.76	-300.00	300.00	.00	.00
BUS 25	1.050	1.050	28.15	220.00	49.79	-47.00	140.00	.00	.00
BUS 26	1.015	1.015	29.93	314.00	9.89	-1000.00	1000.00	.00	.00
BUS 27	.968	.968	15.58	-9.00	2.82	-300.00	300.00	62.00	13.00
BUS 31	.967	.967	12.98	7.00	31.97	-300.00	300.00	43.00	27.00
BUS 32	.963	.964+	15.02	.00	-14.00	-14.00	42.00	59.00	23.00
BUS 34	.984	.986+	11.49	.00	-8.00	-8.00	24.00	59.00	26.00
BUS 36	.980	.980	11.06	.00	-1.23	-8.00	24.00	31.00	17.00
BUS 40	.970	.970	7.51	-46.00	26.89	-300.00	300.00	20.00	23.00
BUS 42	.985	.985	8.66	-59.00	41.00	-300.00	300.00	37.00	23.00
BUS 46	1.005	1.005	18.57	19.00	-5.22	-100.00	100.00	28.00	10.00
BUS 49	1.025	1.025	21.02	204.00	115.75	-85.00	210.00	87.00	30.00
BUS 54	.955	.955	15.35	48.00	4.68	-300.00	300.00	113.00	32.00
BUS 55	.952	.952	15.06	.00	4.66	-8.00	23.00	63.00	22.00
BUS 56	.954	.954	15.24	.00	-2.23	-8.00	15.00	84.00	18.00
BUS 59	.985	.985	19.45	155.00	76.83	-60.00	180.00	277.00	113.00
BUS 61	.995	.995	24.12	160.00	-40.39	-100.00	300.00	.00	.00
BUS 62	.998	.998	23.50	.00	1.16	-20.00	20.00	77.00	14.00
BUS 65	1.005	1.005	27.72	391.00	80.86	-67.00	200.00	.00	.00
BUS 66	1.050	1.050	27.56	392.00	-2.06	-67.00	200.00	39.00	18.00
BUS 70	.984	.984	22.63	.00	8.14	-10.00	32.00	66.00	20.00
BUS 72	.980	.980	21.09	-12.00	-11.12	-100.00	100.00	.00	.00
BUS 73	.991	.991	22.00	-6.00	9.65	-100.00	100.00	.00	.00
BUS 74	.958	.958	21.68	.00	-5.64	-6.00	9.00	68.00	27.00
BUS 76	.943	.943	21.81	.00	5.26	-8.00	23.00	68.00	36.00
BUS 77	1.006	1.006	26.76	.00	11.87	-20.00	70.00	61.00	28.00
BUS 80	1.040	1.040	29.00	477.00	105.00	-165.00	280.00	130.00	26.00
BUS 85	.985	.985	32.55	.00	-5.81	-8.00	23.00	24.00	15.00
BUS 87	1.015	1.015	31.44	4.00	11.02	-100.00	1000.00	.00	.00
BUS 89	1.005	1.005	39.74	607.00	-12.55	-210.00	300.00	.00	.00
BUS 90	.985	.985	33.33	-85.00	59.30	-300.00	300.00	78.00	42.00
BUS 91	.980	.980	33.35	-10.00	-15.07	-100.00	100.00	.00	.00
BUS 92	.990	.993+	33.85	.00	-3.00	-3.00	9.00	65.00	10.00
BUS 99	1.010	1.010	27.08	-42.00	-17.54	-100.00	100.00	.00	.00
BUS 100	1.017	1.017	28.08	252.00	108.08	-50.00	155.00	37.00	18.00

BUS 103	1.010	1.001-	24.48	40.00	40.00	-15.00	40.00	23.00	16.00
BUS 104	.971	.971	21.74	.00	5.60	-8.00	23.00	38.00	25.00
BUS 105	.965	.966+	20.62	.00	-8.00	-8.00	23.00	31.00	26.00
BUS 107	.952	.952	17.58	-22.00	5.70	-200.00	200.00	28.00	12.00
BUS 110	.973	.973	18.14	.00	4.81	-8.00	23.00	39.00	30.00
BUS 111	.980	.980	19.78	36.00	-1.84	-100.00	1000.00	.00	.00
BUS 112	.975	.975	15.04	-43.00	41.51	-100.00	1000.00	25.00	13.00
BUS 113	.993	.993	13.97	-6.00	6.31	-100.00	200.00	.00	.00
BUS 116	1.005	1.005	27.16	-184.00	51.32	-1000.00	1000.00	.00	.00

Bus	Voltage		Load	
BUS 2	.971	11.49	20.00	9.00
BUS 3	.968	11.84	39.00	10.00
BUS 5	1.002	16.00	.00	.00
BUS 7	.989	12.83	19.00	2.00
BUS 9	1.043	28.28	.00	.00
BUS 11	.985	12.99	70.00	23.00
BUS 13	.968	11.61	34.00	16.00
BUS 14	.984	11.75	14.00	1.00
BUS 16	.984	12.17	25.00	10.00
BUS 17	.995	13.98	11.00	3.00
BUS 20	.958	12.16	18.00	3.00
BUS 21	.959	13.74	14.00	8.00
BUS 22	.970	16.29	10.00	5.00
BUS 23	1.000	21.21	7.00	3.00
BUS 28	.962	13.85	17.00	7.00
BUS 29	.963	12.86	24.00	4.00
BUS 30	.986	19.01	.00	.00
BUS 33	.972	10.84	23.00	9.00
BUS 35	.981	11.06	33.00	9.00
BUS 37	.992	11.95	.00	.00
BUS 38	.962	17.09	.00	.00
BUS 39	.970	8.58	27.00	11.00
BUS 41	.967	7.07	37.00	10.00
BUS 43	.978	11.44	18.00	7.00
BUS 44	.985	13.93	16.00	8.00
BUS 45	.987	15.77	53.00	22.00
BUS 47	1.017	20.80	34.00	.00
BUS 48	1.021	20.02	20.00	11.00
BUS 50	1.001	18.98	17.00	4.00
BUS 51	.967	16.36	17.00	8.00
BUS 52	.957	15.41	18.00	5.00
BUS 53	.946	14.44	23.00	11.00
BUS 57	.971	16.45	12.00	3.00
BUS 58	.959	15.59	12.00	3.00
BUS 60	.993	23.23	78.00	3.00
BUS 63	.969	22.82	.00	.00
BUS 64	.984	24.59	.00	.00
BUS 67	1.020	24.92	28.00	7.00
BUS 68	1.003	27.60	.00	.00
BUS 71	.987	22.21	.00	.00
BUS 75	.967	22.94	47.00	11.00
BUS 78	1.003	26.45	71.00	26.00
BUS 79	1.009	26.75	39.00	32.00
BUS 81	.997	28.15	.00	.00
BUS 82	.989	27.28	54.00	27.00
BUS 83	.985	28.47	20.00	10.00
BUS 84	.980	31.00	11.00	7.00
BUS 86	.987	31.18	21.00	10.00
BUS 88	.987	35.68	48.00	10.00
BUS 93	.987	30.84	12.00	7.00
BUS 94	.991	28.69	30.00	16.00
BUS 95	.981	27.72	42.00	31.00
BUS 96	.993	27.55	38.00	15.00
BUS 97	1.011	27.92	15.00	9.00
BUS 98	1.024	27.45	34.00	8.00
BUS 101	.993	29.65	22.00	15.00

BUS 102	.991	32.35	.5.00	3.00
BUS 106	.962	20.37	43.00	16.00
BUS 108	.967	19.43	2.00	1.00
BUS 109	.967	18.98	8.00	3.00
BUS 114	.960	14.69	8.00	3.00
BUS 115	.960	14.68	22.00	7.00
BUS 117	.974	10.93	20.00	8.00
BUS 118	.949	21.95	33.00	15.00

Power Generated:	3800.52	791.41
Power Demanded:	3668.00	1438.00
System Losses:	132.52	-646.59

Printout time: .57

BUS 69	BUS 47	58.69	-10.07
BUS 69	BUS 49	48.78	-12.06
BUS 69	BUS 70	108.20	16.09
BUS 69	BUS 75	109.91	20.50
BUS 69	BUS 77	62.11	6.80
BUS 69	BUS 68	125.84	-103.64
Total:		513.52	-82.38

BUS 1	BUS 2	-12.36	-13.04
BUS 1	BUS 3	-38.64	-17.06
Total:		-51.00	-30.10

BUS 4	BUS 5	-103.21	-26.79
BUS 4	BUS 11	64.21	-.21
Total:		-39.00	-27.01

BUS 6	BUS 5	-87.53	-1.30
BUS 6	BUS 7	35.53	-4.77
Total:		-52.00	-6.07

BUS 8	BUS 9	-440.64	-89.73
BUS 8	BUS 30	74.21	27.76
BUS 8	BUS 5	338.42	124.72
Total:		-28.00	62.75

BUS 10	BUS 9	450.00	-51.04
Total:		450.00	-51.04

BUS 12	BUS 11	-34.14	35.13
BUS 12	BUS 2	32.74	19.42
BUS 12	BUS 3	9.90	8.86
BUS 12	BUS 7	-16.44	5.75
BUS 12	BUS 14	18.28	2.63
BUS 12	BUS 16	7.51	4.29
BUS 12	BUS 117	20.15	5.20
Total:		38.00	81.27

BUS 15	BUS 13	-.74	-2.05
BUS 15	BUS 14	-4.18	-7.84
BUS 15	BUS 17	-103.66	-24.44
BUS 15	BUS 19	11.40	12.39
BUS 15	BUS 33	7.19	-4.87
Total:		-90.00	-26.81

BUS 18	BUS 17	-79.42	-22.48
BUS 18	BUS 19	19.42	13.84
Total:		-60.00	-8.64
BUS 19	BUS 18	-19.35	-14.61
BUS 19	BUS 20	-10.59	5.39
BUS 19	BUS 15	-11.36	-13.21
BUS 19	BUS 34	-3.70	-10.57
Total:		-45.00	-33.00
BUS 24	BUS 23	-8.58	-15.53
BUS 24	BUS 70	-5.64	-1.60
BUS 24	BUS 72	1.22	3.37
Total:		-13.00	-13.76
BUS 25	BUS 23	166.97	38.37
BUS 25	BUS 27	143.48	30.06
BUS 25	BUS 26	-90.45	-18.63
Total:		220.00	49.79
BUS 26	BUS 30	223.56	-11.70
BUS 26	BUS 25	90.45	21.59
Total:		314.00	9.89
BUS 27	BUS 25	-137.08	-15.27
BUS 27	BUS 28	32.84	-.59
BUS 27	BUS 32	12.50	1.01
BUS 27	BUS 115	20.74	4.66
Total:		-71.00	-10.18
BUS 31	BUS 17	-14.63	-14.74
BUS 31	BUS 29	8.46	7.91
BUS 31	BUS 32	-29.83	11.80
Total:		-36.00	4.97
BUS 32	BUS 23	-90.12	-5.95
BUS 32	BUS 31	30.17	-13.02
BUS 32	BUS 27	-12.46	-2.68
BUS 32	BUS 113	4.06	-17.51
BUS 32	BUS 114	9.36	2.17
Total:		-59.00	-37.00
BUS 34	BUS 19	3.76	4.76

BUS 34	BUS 36	30.42	11.48
BUS 34	BUS 37	-94.59	-38.57
BUS 34	BUS 43	1.40	1.93
BUS 34	BUS 34	.00	-13.61
Total:		-59.00	-34.00
BUS 36	BUS 35	-.67	-6.49
BUS 36	BUS 34	-30.33	-11.74
Total:		-31.00	-18.23
BUS 40	BUS 37	-42.91	2.20
BUS 40	BUS 39	-26.80	6.97
BUS 40	BUS 41	15.53	1.17
BUS 40	BUS 42	-11.83	-6.45
Total:		-66.00	3.89
BUS 42	BUS 40	11.92	2.30
BUS 42	BUS 41	21.73	5.25
BUS 42	BUS 49	-64.83	5.22
BUS 42	BUS 49	-64.83	5.22
Total:		-96.00	18.00
BUS 46	BUS 45	36.88	1.93
BUS 46	BUS 47	-31.12	-1.22
BUS 46	BUS 48	-14.76	-5.83
BUS 46	BUS 46	.00	-10.10
Total:		-9.00	-15.22
BUS 49	BUS 47	9.57	9.28
BUS 49	BUS 42	67.99	.37
BUS 49	BUS 42	67.99	.37
BUS 49	BUS 45	51.44	2.17
BUS 49	BUS 48	35.11	-3.93
BUS 49	BUS 50	53.67	13.43
BUS 49	BUS 51	66.63	20.52
BUS 49	BUS 54	37.77	13.07
BUS 49	BUS 54	37.75	11.20
BUS 49	BUS 66	-132.19	4.32
BUS 49	BUS 66	-132.19	4.32
BUS 49	BUS 69	-46.54	10.65
Total:		117.00	85.75
BUS 54	BUS 53	12.73	3.77
BUS 54	BUS 49	-36.58	-15.60
BUS 54	BUS 49	-36.38	-13.79
BUS 54	BUS 55	7.08	1.46
BUS 54	BUS 56	18.54	4.34
BUS 54	BUS 59	-30.38	-7.51

Total:		-65.00	-27.32
BUS 55	BUS 54	-7.07	-3.25
BUS 55	BUS 56	-21.42	-5.82
BUS 55	BUS 59	-34.51	-8.26
Total:		-63.00	-17.34
BUS 56	BUS 54	-18.53	-4.97
BUS 56	BUS 55	21.45	5.56
BUS 56	BUS 57	-22.99	-9.10
BUS 56	BUS 58	-6.66	-3.63
BUS 56	BUS 59	-27.96	-4.18
BUS 56	BUS 59	-29.31	-3.91
Total:		-84.00	-20.23
BUS 59	BUS 54	30.90	4.26
BUS 59	BUS 56	28.67	.99
BUS 59	BUS 56	30.07	1.13
BUS 59	BUS 55	35.15	5.88
BUS 59	BUS 60	-43.31	3.57
BUS 59	BUS 61	-51.72	5.03
BUS 59	BUS 63	-151.76	-57.03
Total:		-122.00	-36.17
BUS 61	BUS 59	52.64	-4.63
BUS 61	BUS 60	112.40	-8.23
BUS 61	BUS 62	25.49	-13.86
BUS 61	BUS 64	-30.52	-13.69
Total:		160.00	-40.39
BUS 62	BUS 60	9.89	5.74
BUS 62	BUS 61	-25.42	13.20
BUS 62	BUS 66	-37.17	-17.36
BUS 62	BUS 67	-24.31	-14.41
Total:		-77.00	-12.84
BUS 65	BUS 38	184.86	-9.04
BUS 65	BUS 64	183.76	40.06
BUS 65	BUS 68	13.91	-22.41
BUS 65	BUS 66	8.48	72.25
Total:		391.00	80.86
BUS 66	BUS 49	135.19	8.33
BUS 66	BUS 49	135.19	8.33
BUS 66	BUS 62	37.93	14.56
BUS 66	BUS 67	53.16	19.27

BUS 66	BUS 65	-8.48	-70.55
Total:		353.00	-20.06
BUS 70	BUS 69	-104.77	-14.05
BUS 70	BUS 24	5.69	-8.17
BUS 70	BUS 71	16.90	-12.44
BUS 70	BUS 74	16.26	12.88
BUS 70	BUS 75	-.07	9.92
Total:		-66.00	-11.86
BUS 72	BUS 24	-1.20	-8.04
BUS 72	BUS 71	-10.80	-3.08
Total:		-12.00	-11.12
BUS 73	BUS 71	-6.00	9.65
Total:		-6.00	9.65
BUS 74	BUS 70	-16.06	-15.41
BUS 74	BUS 75	-51.94	-6.22
BUS 74	BUS 74	.00	-11.01
Total:		-68.00	-32.64
BUS 76	BUS 77	-61.14	-21.04
BUS 76	BUS 118	-6.86	-9.69
Total:		-68.00	-30.74
BUS 77	BUS 76	63.20	24.39
BUS 77	BUS 69	-60.95	-13.85
BUS 77	BUS 75	35.40	7.36
BUS 77	BUS 78	45.39	6.61
BUS 77	BUS 80	-96.58	-37.41
BUS 77	BUS 80	-44.37	-20.54
BUS 77	BUS 82	-3.08	17.30
Total:		-61.00	-16.13
BUS 80	BUS 77	98.36	37.53
BUS 80	BUS 77	45.05	20.59
BUS 80	BUS 79	65.51	31.08
BUS 80	BUS 96	18.92	20.82
BUS 80	BUS 97	26.38	25.51
BUS 80	BUS 98	28.86	8.33
BUS 80	BUS 99	19.47	8.18
BUS 80	BUS 81	44.44	-73.05
Total:		347.00	79.00

BUS 85	BUS 83	43.59	-12.38
BUS 85	BUS 84	36.73	-9.30
BUS 85	BUS 86	17.17	-7.35
BUS 85	BUS 88	-50.32	7.58
BUS 85	BUS 89	-71.17	.66
Total:		-24.00	-20.81

BUS 87	BUS 86	4.00	11.02
Total:		4.00	11.02

BUS 89	BUS 85	72.42	3.73
BUS 89	BUS 88	100.26	7.70
BUS 89	BUS 90	58.17	-4.72
BUS 89	BUS 90	110.73	-5.43
BUS 89	BUS 92	201.82	-7.19
BUS 89	BUS 92	63.60	-6.68
Total:		607.00	-12.58

BUS 90	BUS 89	-56.43	5.79
BUS 90	BUS 89	-107.84	7.04
BUS 90	BUS 91	1.27	4.47
Total:		-163.00	17.30

BUS 91	BUS 90	-1.27	-6.50
BUS 91	BUS 92	-8.74	-8.57
Total:		-10.00	-15.08

BUS 92	BUS 89	-197.83	22.10
BUS 92	BUS 89	-62.02	8.91
BUS 92	BUS 91	8.79	5.56
BUS 92	BUS 93	57.72	-10.63
BUS 92	BUS 94	52.27	-14.19
BUS 92	BUS 100	31.45	-17.20
BUS 92	BUS 102	44.62	-7.56
Total:		-65.00	-13.00

BUS 99	BUS 80	-19.26	-12.96
BUS 99	BUS 100	-22.74	-4.57
Total:		-42.00	-17.54

BUS 100	BUS 92	-30.68	12.90
BUS 100	BUS 94	-3.87	44.33
BUS 100	BUS 98	5.37	-7.31
BUS 100	BUS 99	22.83	2.78
BUS 100	BUS 101	-16.74	21.97

BUS 100	BUS 103	121.08	-4.33
BUS 100	BUS 104	56.42	10.57
BUS 100	BUS 106	60.57	9.17
Total:		214.98	90.07
BUS 103	BUS 100	-118.82	6.31
BUS 103	BUS 104	32.31	7.94
BUS 103	BUS 105	42.95	6.56
BUS 103	BUS 110	60.56	3.19
Total:		17.00	24.00
BUS 104	BUS 100	-54.95	-9.38
BUS 104	BUS 103	-31.78	-10.09
BUS 104	BUS 105	48.73	.06
Total:		-38.00	-19.41
BUS 105	BUS 103	-41.92	-7.39
BUS 105	BUS 104	-48.48	-.04
BUS 105	BUS 106	8.68	4.55
BUS 105	BUS 107	26.73	-1.85
BUS 105	BUS 108	23.99	-10.61
BUS 105	BUS 105	.00	-18.66
Total:		-31.00	-34.00
BUS 107	BUS 105	-26.33	-1.09
BUS 107	BUS 106	-23.67	.22
BUS 107	BUS 107	.00	-5.44
Total:		-50.00	-6.30
BUS 110	BUS 103	-59.11	-1.08
BUS 110	BUS 109	-13.64	11.23
BUS 110	BUS 111	-35.70	.96
BUS 110	BUS 112	69.46	-30.61
BUS 110	BUS 110	.00	-5.68
Total:		-39.00	-25.19
BUS 111	BUS 110	36.00	-1.84
Total:		36.00	-1.84
BUS 112	BUS 110	-68.00	28.51
Total:		-68.00	28.51
BUS 113	BUS 17	-2.11	-6.78
BUS 113	BUS 32	-3.89	13.09

Total:		-6.00	6.31
BUS 116	BUS 68	-184.00	51.32
Total:		-184.00	51.32
BUS 2	BUS 1	12.45	11.01
BUS 2	BUS 12	-32.45	-20.01
Total:		-20.00	-9.00
BUS 3	BUS 1	38.89	16.89
BUS 3	BUS 5	-68.10	-14.49
BUS 3	BUS 12	-9.79	-12.39
Total:		-39.00	-10.00
BUS 5	BUS 4	103.42	27.49
BUS 5	BUS 3	69.34	17.28
BUS 5	BUS 6	88.46	4.11
BUS 5	BUS 11	77.21	2.97
BUS 5	BUS 8	-338.42	-92.01
BUS 5	BUS 5	.00	40.16
Total:		.00	.00
BUS 7	BUS 6	-35.47	4.50
BUS 7	BUS 12	16.47	-6.50
Total:		-19.00	-2.00
BUS 9	BUS 8	445.26	24.43
BUS 9	BUS 10	-445.26	-24.43
Total:		.00	.00
BUS 11	BUS 4	-63.35	1.34
BUS 11	BUS 5	-76.00	-.63
BUS 11	BUS 12	34.29	-35.13
BUS 11	BUS 13	35.06	11.41
Total:		-70.00	-23.00
BUS 13	BUS 11	-34.74	-12.16
BUS 13	BUS 15	.74	-3.84
Total:		-34.00	-16.00
BUS 14	BUS 12	-18.21	-4.15
BUS 14	BUS 15	4.21	3.15

	Total:	-14.00	-1.00
BUS 16	BUS 12	-7.49	-6.30
BUS 16	BUS 17	-17.51	-3.70
	Total:	-25.00	-10.00
BUS 17	BUS 15	105.24	25.37
BUS 17	BUS 16	17.65	-.29
BUS 17	BUS 18	80.30	24.85
BUS 17	BUS 31	14.83	11.53
BUS 17	BUS 113	2.11	6.03
BUS 17	BUS 30	-231.13	-70.50
BUS 17	BUS 17	.00	.00
	Total:	-11.00	-3.00
BUS 20	BUS 19	10.63	-7.94
BUS 20	BUS 21	-28.63	4.94
	Total:	-18.00	-3.00
BUS 21	BUS 20	28.80	-6.13
BUS 21	BUS 22	-42.80	-1.87
	Total:	-14.00	-8.00
BUS 22	BUS 21	43.22	1.51
BUS 22	BUS 23	-53.22	-6.51
	Total:	-10.00	-5.00
BUS 23	BUS 22	54.26	7.42
BUS 23	BUS 24	8.61	10.72
BUS 23	BUS 25	-162.76	-25.87
BUS 23	BUS 32	92.89	4.73
	Total:	-7.00	-3.00
BUS 28	BUS 27	-32.62	-.44
BUS 28	BUS 29	15.62	-6.56
	Total:	-17.00	-7.00
BUS 29	BUS 28	-15.55	4.63
BUS 29	BUS 31	-8.45	-8.63
	Total:	-24.00	-4.00
BUS 30	BUS 8	-73.86	-75.07

BUS 30	BUS 26	-219.59	-36.42
BUS 30	BUS 38	62.31	18.11
BUS 30	BUS 17	231.13	93.38
Total:		.00	.00

BUS 33	BUS 15	-7.16	1.94
BUS 33	BUS 37	-15.84	-10.94
Total:		-23.00	-9.00

BUS 35	BUS 36	.67	6.24
BUS 35	BUS 37	-33.67	-15.24
Total:		-33.00	-9.00

BUS 37	BUS 35	33.83	14.65
BUS 37	BUS 33	15.98	7.92
BUS 37	BUS 34	94.86	38.61
BUS 37	BUS 39	54.94	3.75
BUS 37	BUS 40	44.08	-2.93
BUS 37	BUS 38	-243.69	-86.61
BUS 37	BUS 37	.00	24.60
Total:		.00	.00

BUS 38	BUS 30	-62.05	-55.15
BUS 38	BUS 65	-181.64	-56.95
BUS 38	BUS 37	243.69	112.10
Total:		.00	.00

BUS 39	BUS 37	-53.95	-3.07
BUS 39	BUS 40	26.95	-7.93
Total:		-27.00	-11.00

BUS 41	BUS 40	-15.49	-2.20
BUS 41	BUS 42	-21.51	-7.80
Total:		-37.00	-10.00

BUS 43	BUS 44	-16.61	-1.02
BUS 43	BUS 34	-1.39	-5.98
Total:		-18.00	-7.00

BUS 44	BUS 43	16.78	-4.11
BUS 44	BUS 45	-32.78	5.81
BUS 44	BUS 44	.00	-9.70
Total:		-16.00	-8.00

BUS 45	BUS 44	33.04	-6.95
BUS 45	BUS 46	-36.34	-3.37
BUS 45	BUS 49	-49.71	-1.94
BUS 45	BUS 45	.00	-9.73
Total:		-53.00	-22.00

BUS 47	BUS 46	31.48	-.80
BUS 47	BUS 49	-9.54	-10.84
BUS 47	BUS 69	-55.94	11.63
Total:		-34.00	.00

BUS 48	BUS 46	14.90	1.42
BUS 48	BUS 49	-34.90	3.21
BUS 48	BUS 48	.00	-15.63
Total:		-20.00	-11.00

BUS 50	BUS 49	-52.88	-13.14
BUS 50	BUS 57	35.88	9.14
Total:		-17.00	-4.00

BUS 51	BUS 49	-64.35	-17.47
BUS 51	BUS 52	28.57	6.38
BUS 51	BUS 58	18.78	3.10
Total:		-17.00	-8.00

BUS 52	BUS 51	-28.38	-7.12
BUS 52	BUS 53	10.38	2.12
Total:		-18.00	-5.00

BUS 53	BUS 52	-10.32	-5.58
BUS 53	BUS 54	-12.68	-5.42
Total:		-23.00	-11.00

BUS 57	BUS 56	23.22	7.49
BUS 57	BUS 50	-35.22	-10.49
Total:		-12.00	-3.00

BUS 58	BUS 56	6.68	1.47
BUS 58	BUS 51	-18.68	-4.47
Total:		-12.00	-3.00

BUS 60	BUS 59	43.94	-4.40
BUS 60	BUS 61	-112.06	8.52
BUS 60	BUS 62	-9.87	-7.11
Total:		-78.00	-3.00
BUS 63	BUS 64	-151.76	-67.48
BUS 63	BUS 59	151.76	67.48
Total:		.00	.00
BUS 64	BUS 63	152.24	52.51
BUS 64	BUS 65	-182.76	-66.49
BUS 64	BUS 61	30.52	13.99
Total:		.00	.00
BUS 67	BUS 62	24.50	12.15
BUS 67	BUS 66	-52.50	-19.15
Total:		-28.00	-7.00
BUS 68	BUS 65	-13.90	-41.87
BUS 68	BUS 81	-44.38	-4.60
BUS 68	BUS 116	184.13	-66.35
BUS 68	BUS 69	-125.84	112.82
Total:		.00	.00
BUS 71	BUS 70	-16.86	11.74
BUS 71	BUS 72	10.85	-1.00
BUS 71	BUS 73	6.01	-10.74
Total:		.00	.00
BUS 75	BUS 70	.13	-13.15
BUS 75	BUS 69	-105.06	-18.35
BUS 75	BUS 74	52.31	6.47
BUS 75	BUS 77	-34.60	-9.57
BUS 75	BUS 118	40.22	23.59
Total:		-47.00	-11.00
BUS 78	BUS 77	-45.31	-7.63
BUS 78	BUS 79	-25.69	-18.37
Total:		-71.00	-26.00
BUS 79	BUS 78	25.74	17.95
BUS 79	BUS 80	-64.74	-29.58
BUS 79	BUS 79	.00	-20.37

	Total:	-39.00	-32.00
BUS 81	BUS 68	44.44	-75.55
BUS 81	BUS 80	-44.44	75.55
	Total:	.00	.00
BUS 82	BUS 77	3.22	-25.04
BUS 82	BUS 83	-47.09	24.51
BUS 82	BUS 96	-10.13	-6.91
BUS 82	BUS 82	.00	-19.55
	Total:	-54.00	-27.00
BUS 83	BUS 82	47.42	-27.12
BUS 83	BUS 84	-24.72	14.73
BUS 83	BUS 85	-42.70	12.08
BUS 83	BUS 83	.00	-9.69
	Total:	-20.00	-10.00
BUS 84	BUS 83	25.28	-16.05
BUS 84	BUS 85	-36.28	9.05
	Total:	-11.00	-7.00
BUS 86	BUS 85	-17.05	5.09
BUS 86	BUS 87	-3.95	-15.09
	Total:	-21.00	-10.00
BUS 88	BUS 85	50.86	-7.52
BUS 88	BUS 89	-98.86	-2.48
	Total:	-48.00	-10.00
BUS 93	BUS 92	-56.83	11.44
BUS 93	BUS 94	44.84	-18.45
	Total:	-11.99	-7.01
BUS 94	BUS 92	-50.86	14.82
BUS 94	BUS 93	-44.31	18.36
BUS 94	BUS 95	40.99	9.38
BUS 94	BUS 96	19.93	-9.41
BUS 94	BUS 100	4.26	-49.14
	Total:	-30.00	-16.01
BUS 95	BUS 94	-40.75	-9.67

BUS 95	BUS 96	-1.25	-21.33
Total:		-42.00	-31.00
BUS 96	BUS 80	-18.62	-24.40
BUS 96	BUS 82	10.15	1.64
BUS 96	BUS 94	-19.80	7.56
BUS 96	BUS 95	1.33	20.14
BUS 96	BUS 97	-11.06	-19.94
Total:		-38.00	-15.00
BUS 97	BUS 80	-26.14	-26.96
BUS 97	BUS 96	11.14	17.96
Total:		-15.00	-9.00
BUS 98	BUS 80	-28.65	-10.45
BUS 98	BUS 100	-5.35	2.45
Total:		-34.00	-8.00
BUS 101	BUS 100	16.96	-24.26
BUS 101	BUS 102	-38.97	9.26
Total:		-22.00	-15.00
BUS 102	BUS 92	-44.36	7.27
BUS 102	BUS 101	39.37	-10.29
Total:		-4.99	-3.02
BUS 106	BUS 100	-58.34	-6.78
BUS 106	BUS 105	-8.66	-5.82
BUS 106	BUS 107	24.00	-3.40
Total:		-43.00	-16.00
BUS 108	BUS 105	-23.80	9.39
BUS 108	BUS 109	21.81	-10.39
Total:		-2.00	-1.00
BUS 109	BUS 108	-21.74	9.86
BUS 109	BUS 110	13.74	-12.86
Total:		-8.00	-3.00
BUS 114	BUS 32	-9.34	-3.61
BUS 114	BUS 115	1.34	.61
Total:		-8.00	-3.00

BUS 115	BUS 27	-20.66	-6.13
BUS 115	BUS 114	-1.34	-.87
Total:		-22.00	-7.00

BUS 117	BUS 12	-20.00	-8.00
Total:		-20.00	-8.00

BUS 118	BUS 75	-39.88	-23.56
BUS 118	BUS 76	6.88	8.56
Total:		-33.00	-15.00

System losses:	132.52	-646.68
R*I**2,X*I**2:	132.52	781.31

Appendix E

IEEE 14 Bus Network

FDLF Based Results

D.1. Transmission line data
Transformer data
Shunt stepped data

D.2. Bus oriented results

D.3. Line flow results

Sbase: 100.

Transmission Lines

NO	NE	R %	X %	X/R	wC*Sbase	Length
BUS 1	BUS 2	1.938	5.917	3.05	5.280	29.8
BUS 1	BUS 5	5.403	22.304	4.13	4.920	94.4
BUS 2	BUS 3	4.699	19.797	4.21	4.380	82.8
BUS 2	BUS 4	5.811	17.632	3.03	3.740	89.2
BUS 2	BUS 5	5.695	17.388	3.05	3.400	87.6
BUS 3	BUS 4	6.701	17.103	2.55	3.460	96.6
BUS 4	BUS 5	1.335	4.211	3.15	1.280	20.8
BUS 6	BUS 11	9.498	19.890	2.09		12.4
BUS 6	BUS 12	12.291	25.581	2.08		16.1
BUS 6	BUS 13	6.615	13.027	1.97		8.4
BUS 7	BUS 8	.000	17.615			
BUS 7	BUS 9	.000	11.001			
BUS 9	BUS 10	3.181	8.450	2.66		46.5
BUS 9	BUS 14	12.711	27.038	2.13		16.8
BUS 10	BUS 11	8.205	19.207	2.34		11.4
BUS 12	BUS 13	22.092	19.988	.90		20.5
BUS 13	BUS 14	17.093	34.802	2.04		22.1

Transformers

NO	NE	R %	X %	Tap
BUS 4	BUS 7	.000	20.912	.978
BUS 4	BUS 9	.000	55.618	.969
BUS 5	BUS 6	.000	25.202	.932

Shunt Elements

NO	wC*Sbase
BUS 9	19.000

```
    Time for input:    .09
    Time for compact:    .01
    Time for factorization:    .00
lo. of iterations:  4
laximum mismatch (in pu):  8.4E-04 1.3E-04
    Time for solution:    .01
:xecution time:    .10

; base : 100.
```

Bus	Vsp	Voltage		Generation		QGmin	QGmax	Load	
US 1		1.060	.00	232.38	-16.89				
US 2	1.045	1.045	-4.98	40.00	42.39	-40.00	50.00	21.70	12.70
US 3	1.010	1.010	-12.72	.00	23.39	.00	40.00	94.20	19.00
US 6	1.070	1.070	-14.22	.00	12.24	-6.00	24.00	11.20	7.50
US 8	1.090	1.090	-13.37	.00	17.36	-6.00	24.00	.00	.00

Bus	Voltage		Load	
BUS 4	1.019	-10.32	47.80	-3.90
BUS 5	1.020	-8.78	7.60	1.60
BUS 7	1.062	-13.37	.00	.00
BUS 9	1.056	-14.95	29.50	16.60
BUS 10	1.051	-15.10	9.00	5.80
BUS 11	1.057	-14.80	3.50	1.80
BUS 12	1.055	-15.08	6.10	1.60
BUS 13	1.050	-15.16	13.50	5.80
BUS 14	1.036	-16.04	14.90	5.00

Power Generated:	272.38	78.50
Power Demanded:	259.00	73.50
System Losses:	13.38	5.00

Printout time: .07

BUS 1	BUS 2	156.83	-20.39
BUS 1	BUS 5	75.55	3.50
Total:		232.38	-16.89

BUS 2	BUS 1	-152.53	27.65
BUS 2	BUS 3	73.19	3.57
BUS 2	BUS 4	56.14	-2.29
BUS 2	BUS 5	41.51	.76
Total:		18.30	29.69

BUS 3	BUS 2	-70.87	1.58
BUS 3	BUS 4	-23.33	2.81
Total:		-94.20	4.39

BUS 6	BUS 11	7.34	3.47
BUS 6	BUS 12	7.78	2.49
BUS 6	BUS 13	17.74	7.17
BUS 6	BUS 5	-44.06	-8.40
Total:		-11.20	4.74

BUS 8	BUS 7	.00	17.36
Total:		.00	17.36

BUS 4	BUS 2	-54.46	3.39
BUS 4	BUS 3	23.70	-5.42
BUS 4	BUS 5	-61.22	15.67
BUS 4	BUS 7	28.09	-9.42
BUS 4	BUS 9	16.09	-.32
Total:		-47.80	3.90

BUS 5	BUS 1	-72.79	2.58
BUS 5	BUS 2	-40.61	-1.63
BUS 5	BUS 4	61.73	-15.37
BUS 5	BUS 6	44.06	12.82
Total:		-7.61	-1.60

BUS 7	BUS 8	.00	-16.91
BUS 7	BUS 9	28.09	5.80
BUS 7	BUS 4	-28.09	11.11
Total:		.00	.00

BUS 9	BUS 7	-28.09	-5.00
BUS 9	BUS 10	5.24	4.31

9	BUS 14	9.44	3.67
9	BUS 4	-16.09	1.62
9	BUS 9	.00	-21.20
Total:		-29.50	-16.60
10	BUS 9	-5.23	-4.27
10	BUS 11	-3.77	-1.53
Total:		-9.00	-5.80
11	BUS 6	-7.29	-3.36
11	BUS 10	3.79	1.56
Total:		-3.50	-1.80
12	BUS 6	-7.71	-2.34
12	BUS 13	1.61	.74
Total:		-6.10	-1.60
13	BUS 6	-17.53	-6.75
13	BUS 12	-1.60	-.74
13	BUS 14	5.63	1.69
Total:		-13.50	-5.80
14	BUS 9	-9.32	-3.42
14	BUS 13	-5.58	-1.58
Total:		-14.90	-5.00

em losses: 13.39 5.00

Appendix F

250 Bus Network

Updated Line Values

NO	NE	R	X	X/R	wC	wCcomp	wCset	Length
BUS 1	BUS 2	3.030	9.990	3.30	2.540	3.122	2.540	48.0
BUS 1	BUS 3	1.290	4.240	3.29	1.082	1.328	1.082	20.4
BUS 4	BUS 5	.176	.798	4.53	.210	.209	.210	3.2
BUS 3	BUS 5	2.410	10.800	4.48	2.840	2.843	2.840	43.7
BUS 5	BUS 6	1.190	5.400	4.54	1.426	1.412	1.426	21.7
BUS 6	BUS 7	.459	2.080	4.53	.550	.544	.550	8.4
BUS 8	BUS 9	.244	3.050	12.50	116.200	48.536	48.536*	90.5
BUS 9	BUS 10	.258	3.220	12.48	123.000	51.278	51.278*	95.6
BUS 4	BUS 11	2.090	6.880	3.29	1.748	2.152	1.748	33.1
BUS 5	BUS 11	2.030	6.820	3.36	1.738	2.108	1.738	32.4
BUS 11	BUS 12	.595	1.960	3.29	.502	.613	.502	9.4
BUS 2	BUS 12	1.870	6.160	3.29	1.572	1.926	1.572	29.6
BUS 3	BUS 12	4.840	16.000	3.31	4.060	4.993	4.060	76.8
BUS 7	BUS 12	.862	3.400	3.94	.874	.959	.874	14.7
BUS 11	BUS 13	2.225	7.310	3.29	1.876	2.290	1.876	35.2
BUS 12	BUS 14	2.150	7.070	3.29	1.816	2.213	1.816	34.0
BUS 13	BUS 15	7.440	24.440	3.28	6.268	7.656	6.268	117.8
BUS 14	BUS 15	5.950	19.500	3.28	5.020	6.117	5.020	94.1
BUS 12	BUS 16	2.120	8.340	3.93	2.140	2.355	2.140	36.2
BUS 15	BUS 17	1.320	4.370	3.31	4.440	1.363	1.363*	21.0
BUS 16	BUS 17	4.540	18.010	3.97	4.660	5.061	4.660	77.9
BUS 17	BUS 18	1.230	5.050	4.11	1.298	1.393	1.298	21.4
BUS 18	BUS 19	1.190	4.930	4.14	1.142	1.353	1.142	20.8
BUS 19	BUS 20	2.520	11.700	4.64	2.980	3.024	2.980	46.5
BUS 15	BUS 19	1.200	3.940	3.28	1.010	1.235	1.010	19.0
BUS 20	BUS 21	1.830	8.490	4.64	2.160	2.195	2.160	33.8
BUS 21	BUS 22	2.090	9.700	4.64	2.460	2.507	2.460	38.6
BUS 22	BUS 23	3.420	15.900	4.65	4.040	4.107	4.040	63.2
BUS 23	BUS 24	1.350	4.920	3.64	4.980	1.450	1.450*	22.3
BUS 23	BUS 25	1.560	8.000	5.13	8.640	1.967	1.967*	30.3
BUS 25	BUS 27	3.180	16.300	5.13	17.640	4.009	4.009*	61.7
BUS 27	BUS 28	1.913	8.550	4.47	2.160	2.254	2.160	34.7
BUS 28	BUS 29	2.370	9.430	3.98	2.380	2.646	2.380	40.7
BUS 8	BUS 30	.431	5.040	11.69	51.400	82.752	51.400	154.3
BUS 26	BUS 30	.799	8.600	10.76	90.800	147.030	90.800	274.2
BUS 17	BUS 31	4.740	15.630	3.30	3.990	4.885	3.990	75.2
BUS 29	BUS 31	1.080	3.310	3.06	.830	1.081	.830	16.6
BUS 23	BUS 32	3.170	11.530	3.64	11.730	3.402	3.402*	52.3
BUS 31	BUS 32	2.980	9.850	3.31	2.510	3.074	2.510	47.3
BUS 27	BUS 32	2.290	7.550	3.30	1.926	2.360	1.926	36.3
BUS 15	BUS 33	3.800	12.440	3.27	3.194	3.905	3.194	60.1
BUS 19	BUS 34	7.520	24.700	3.28	6.320	7.738	6.320	119.0
BUS 35	BUS 36	.224	1.020	4.55	.268	.266	.268	4.1
BUS 35	BUS 37	1.100	4.970	4.52	1.318	1.303	1.318	20.0
BUS 33	BUS 37	4.150	14.200	3.42	3.660	4.342	3.660	66.8
BUS 34	BUS 36	.871	2.680	3.08	.568	.873	.568	13.4
BUS 34	BUS 37	.256	.940	3.67	.984	.276	.276*	4.2
BUS 37	BUS 39	3.210	10.600	3.30	2.700	3.310	2.700	50.9
BUS 37	BUS 40	5.930	16.800	2.83	4.200	5.764	4.200	88.7
BUS 30	BUS 38	.464	5.400	11.64	42.200	88.865	42.200	165.7
BUS 39	BUS 40	1.840	6.050	3.29	1.552	1.894	1.552	29.1

NO	NE	R	X	X/R	wC	wCcomp	wCset	Length
BUS 40	BUS 41	1.450	4.780	3.30	1.222	1.494	1.222	23.0
BUS 40	BUS 42	5.550	18.300	3.30	4.660	5.720	4.660	88.0
BUS 41	BUS 42	4.100	13.500	3.29	3.440	4.223	3.440	65.0
BUS 43	BUS 44	6.080	24.540	4.04	6.068	6.831	6.068	105.1
BUS 34	BUS 43	4.130	16.810	4.07	4.226	4.658	4.226	71.7
BUS 44	BUS 45	2.240	9.010	4.02	2.240	2.513	2.240	38.7
BUS 45	BUS 46	4.000	13.560	3.39	3.320	4.169	3.320	64.1
BUS 46	BUS 47	3.800	12.700	3.34	3.160	3.937	3.160	60.6
BUS 46	BUS 48	6.010	18.900	3.14	4.720	6.078	4.720	93.5
BUS 47	BUS 49	1.910	6.250	3.27	1.604	1.962	1.604	30.2
BUS 42	BUS 49	7.150	32.300	4.52	8.600	8.467	8.600	130.3
BUS 42	BUS 49	7.150	32.300	4.52	8.600	8.467	8.600	130.3
BUS 45	BUS 49	6.840	18.600	2.72	4.440	6.551	4.440	100.8
BUS 48	BUS 49	1.790	5.050	2.82	1.258	1.737	1.258	26.7
BUS 49	BUS 50	2.670	7.520	2.82	1.874	2.590	1.874	39.8
BUS 49	BUS 51	4.860	13.700	2.82	3.420	4.716	3.420	72.5
BUS 51	BUS 52	2.030	5.880	2.90	1.396	1.990	1.396	30.6
BUS 52	BUS 53	4.050	16.350	4.04	4.060	4.551	4.060	70.0
BUS 53	BUS 54	2.630	12.200	4.64	2.100	3.155	2.100	48.5
BUS 49	BUS 54	7.300	28.900	3.96	7.380	8.131	7.380	125.1
BUS 49	BUS 54	8.690	29.100	3.35	7.300	9.012	7.300	138.6
BUS 54	BUS 55	1.690	7.070	4.18	2.020	1.930	2.020	29.7
BUS 54	BUS 56	.275	.955	3.47	.732	.289	.289*	4.5
BUS 55	BUS 56	.488	1.510	3.09	.374	.490	.374	7.5
BUS 56	BUS 57	3.430	9.660	2.82	2.420	3.327	2.420	51.2
BUS 50	BUS 57	4.740	13.400	2.83	3.320	4.604	3.320	70.8
BUS 56	BUS 58	3.430	9.660	2.82	2.420	3.327	2.420	51.2
BUS 51	BUS 58	2.550	7.190	2.82	1.788	2.475	1.788	38.1
BUS 54	BUS 59	5.030	22.930	4.56	5.980	5.982	5.980	92.0
BUS 56	BUS 59	8.250	25.100	3.04	5.690	8.237	5.690	126.7
BUS 56	BUS 59	8.030	23.900	2.98	5.360	7.951	5.360	122.3
BUS 55	BUS 59	4.739	21.580	4.55	5.646	5.633	5.646	86.7
BUS 59	BUS 60	3.170	14.500	4.57	3.760	3.776	3.760	58.1
BUS 59	BUS 61	3.280	15.000	4.57	3.880	3.907	3.880	60.1
BUS 60	BUS 61	.264	1.350	5.11	1.456	.332	.332*	5.1
BUS 60	BUS 62	1.230	5.610	4.56	1.468	1.463	1.468	22.5
BUS 61	BUS 62	.824	3.760	4.56	.980	.980	.980	15.1
BUS 63	BUS 64	.172	2.000	11.63	21.600	32.927	21.600	61.4
BUS 38	BUS 65	.901	9.860	10.94	104.600	167.190	104.600	311.8
BUS 64	BUS 65	.269	3.020	11.23	38.000	50.570	38.000	94.3
BUS 49	BUS 66	1.800	9.190	5.11	2.480	2.265	2.480	34.8
BUS 49	BUS 66	1.800	9.190	5.11	2.480	2.265	2.480	34.8
BUS 62	BUS 66	4.820	21.800	4.52	5.980	5.711	5.980	87.9
BUS 62	BUS 67	2.580	11.700	4.53	3.100	3.061	3.100	47.1
BUS 66	BUS 67	2.240	10.150	4.53	2.682	2.656	2.682	40.9
BUS 65	BUS 68	.138	1.600	11.59	63.800	26.378	26.378*	49.2
BUS 47	BUS 69	8.440	27.780	3.29	7.092	8.692	7.092	133.7
BUS 49	BUS 69	9.850	32.400	3.29	8.280	10.141	8.280	156.0
BUS 69	BUS 70	3.000	12.700	4.23	12.200	3.445	3.445*	53.0
BUS 24	BUS 70	10.221	41.150	4.03	10.200	11.471	10.200	176.5
BUS 70	BUS 71	.882	3.550	4.02	.880	.990	.880	15.2
BUS 24	BUS 72	4.880	19.600	4.02	4.880	5.471	4.880	84.2

NO	NE	R	X	X/R	wC	wCcomp	wCset	Length
BUS 71	BUS 72	4.460	18.000	4.04	4.444	5.011	4.444	77.1
BUS 71	BUS 73	.866	4.540	5.24	1.180	1.105	1.180	17.0
BUS 70	BUS 74	4.010	13.230	3.30	3.368	4.133	3.368	63.6
BUS 70	BUS 75	4.280	14.100	3.29	3.600	4.409	3.600	67.8
BUS 69	BUS 75	4.050	12.200	3.01	12.400	4.028	4.028*	62.0
BUS 74	BUS 75	1.230	4.060	3.30	1.034	1.268	1.034	19.5
BUS 76	BUS 77	4.440	14.800	3.33	3.680	4.596	3.680	70.7
BUS 69	BUS 77	3.090	10.100	3.27	10.400	3.173	3.173*	48.8
BUS 75	BUS 77	6.010	19.990	3.33	5.000	6.215	5.000	95.6
BUS 77	BUS 78	.376	1.240	3.30	1.264	.388	.388*	6.0
BUS 78	BUS 79	.546	2.440	4.47	.648	.643	.648	9.9
BUS 77	BUS 80	1.700	4.850	2.85	4.720	1.657	1.657*	25.5
BUS 77	BUS 80	2.940	10.500	3.57	2.280	3.131	2.280	48.2
BUS 79	BUS 80	1.560	7.040	4.51	1.870	1.846	1.870	28.4
BUS 68	BUS 81	.175	2.020	11.54	80.800	33.373	33.373*	62.2
BUS 77	BUS 82	2.980	8.530	2.86	8.180	2.908	2.908*	44.7
BUS 82	BUS 83	1.120	3.665	3.27	3.800	1.151	1.151*	17.7
BUS 83	BUS 84	5.180	13.200	2.55	2.600	4.850	2.600	74.6
BUS 83	BUS 85	4.300	14.800	3.44	3.480	4.510	3.480	69.4
BUS 84	BUS 85	2.510	6.410	2.55	1.234	2.352	1.234	36.2
BUS 85	BUS 86	3.500	12.300	3.51	2.760	3.703	2.760	57.0
BUS 86	BUS 87	2.828	20.740	7.33	4.450	35.892	35.892*	201.5
BUS 85	BUS 88	2.000	10.200	5.10	2.760	2.515	2.760	38.7
BUS 85	BUS 89	2.390	17.300	7.24	4.700	30.120	30.120*	169.1
BUS 88	BUS 89	1.390	7.120	5.12	1.934	1.752	1.934	27.0
BUS 89	BUS 90	5.180	18.800	3.63	5.280	5.555	5.280	85.5
BUS 89	BUS 90	2.380	9.970	4.19	10.600	2.720	2.720*	41.8
BUS 90	BUS 91	2.540	8.360	3.29	2.140	2.616	2.140	40.2
BUS 89	BUS 92	.990	5.050	5.10	5.480	1.245	1.245*	19.2
BUS 89	BUS 92	3.930	15.810	4.02	4.140	4.409	4.140	67.8
BUS 91	BUS 92	3.870	12.720	3.29	3.268	3.983	3.268	61.3
BUS 92	BUS 93	2.580	8.480	3.29	2.180	2.655	2.180	40.9
BUS 92	BUS 94	4.810	15.800	3.28	4.060	4.949	4.060	76.1
BUS 93	BUS 94	2.230	7.320	3.28	1.876	2.294	1.876	35.3
BUS 94	BUS 95	1.320	4.340	3.29	1.110	1.359	1.110	20.9
BUS 80	BUS 96	3.560	18.200	5.11	4.940	4.482	4.940	69.0
BUS 82	BUS 96	1.620	5.300	3.27	5.440	1.664	1.664*	25.6
BUS 94	BUS 96	2.690	8.690	3.23	2.300	2.750	2.300	42.3
BUS 80	BUS 97	1.830	9.340	5.10	2.540	2.302	2.540	35.4
BUS 80	BUS 98	2.380	10.800	4.54	2.860	2.824	2.860	43.5
BUS 80	BUS 99	4.540	20.600	4.54	5.460	5.388	5.460	82.9
BUS 92	BUS 100	6.480	29.500	4.55	7.720	7.702	7.720	118.5
BUS 94	BUS 100	1.780	5.800	3.26	6.040	1.826	1.826*	28.1
BUS 95	BUS 96	1.710	5.470	3.20	1.474	1.741	1.474	26.8
BUS 96	BUS 97	1.730	8.850	5.12	2.400	2.179	2.400	33.5
BUS 98	BUS 100	3.970	17.900	4.51	4.760	4.697	4.760	72.3
BUS 99	BUS 100	1.800	8.130	4.52	2.160	2.131	2.160	32.8
BUS 100	BUS 101	2.770	12.620	4.56	3.280	3.294	3.280	50.7
BUS 92	BUS 102	1.230	5.590	4.54	1.464	1.461	1.464	22.5
BUS 101	BUS 102	2.460	11.200	4.55	2.940	2.924	2.940	45.0
BUS 100	BUS 103	1.600	5.250	3.28	5.360	1.646	1.646*	25.3
BUS 100	BUS 104	4.510	20.400	4.52	5.510	5.344	5.510	82.2

NO	NE	R	X	X/R	wC	wCcomp	wCset	Length
BUS 103	BUS 104	4.660	15.840	3.40	4.070	4.862	4.070	74.8
BUS 103	BUS 105	5.350	16.250	3.04	4.080	5.338	4.080	82.1
BUS 100	BUS 106	6.050	22.900	3.79	6.200	6.606	6.200	101.6
BUS 104	BUS 105	.994	3.780	3.80	.986	1.088	.986	16.7
BUS 105	BUS 106	1.400	5.470	3.91	1.434	1.550	1.434	23.9
BUS 105	BUS 107	5.300	18.300	3.45	4.720	5.566	4.720	85.6
BUS 105	BUS 108	2.610	7.030	2.69	1.844	2.491	1.844	38.3
BUS 106	BUS 107	5.300	18.300	3.45	4.720	5.566	4.720	85.6
BUS 108	BUS 109	1.050	2.880	2.74	.760	1.009	.760	15.5
BUS 103	BUS 110	3.906	18.130	4.64	4.710	4.686	4.710	72.1
BUS 109	BUS 110	2.780	7.620	2.74	2.020	2.670	2.020	41.1
BUS 110	BUS 111	2.200	7.550	3.43	2.000	2.304	2.000	35.5
BUS 110	BUS 112	2.470	6.400	2.59	6.200	2.326	2.326*	35.8
BUS 17	BUS 113	.913	3.010	3.30	.768	.941	.768	14.5
BUS 32	BUS 113	6.150	20.300	3.30	5.180	6.341	5.180	97.5
BUS 32	BUS 114	1.350	6.120	4.53	1.626	1.601	1.626	24.6
BUS 27	BUS 115	1.640	7.410	4.52	1.972	1.942	1.972	29.9
BUS 114	BUS 115	.230	1.040	4.52	.276	.272	.276	4.2
BUS 68	BUS 116	.034	.405	11.91	16.400	6.592	6.592*	12.3
BUS 12	BUS 117	3.290	14.000	4.26	3.580	3.787	3.580	58.3
BUS 75	BUS 118	1.450	4.810	3.32	1.200	1.498	1.200	23.0
BUS 76	BUS 118	1.640	5.440	3.32	1.356	1.694	1.356	26.1
A 1	A 2	1.920	5.750	2.99	2.640	1.906	2.640	29.3
A 1	A 3	4.520	18.520	4.10	2.040	5.113	2.040	78.7
A 2	A 4	5.700	17.370	3.05	1.840	5.695	5.695*	87.6
A 3	A 4	1.320	3.790	2.87	.420	1.289	1.289*	19.8
A 2	A 5	4.720	19.830	4.20	2.090	5.401	2.090	83.1
A 2	A 6	5.810	17.630	3.03	1.870	5.795	5.795*	89.2
A 4	A 6	1.190	4.140	3.48	.450	1.254	.450	19.3
A 5	A 7	4.600	13.800	3.00	1.020	4.568	4.568*	70.3
A 6	A 7	2.670	8.200	3.07	.850	2.676	2.676*	41.2
A 6	A 8	1.200	4.200	3.50	.450	1.267	.450	19.5
A 6	A 28	1.690	5.990	3.54	.650	1.794	.650	27.6
A 8	A 28	6.360	20.000	3.14	2.140	6.432	2.140	99.0
A 9	A 11	.000	20.800					
A 9	A 10	.000	11.000					
A 12	A 13	.000	14.000					
A 12	A 14	12.310	25.590	2.08				16.1
A 12	A 15	6.620	13.040	1.97				8.4
A 12	A 16	9.450	19.870	2.10				12.4
A 14	A 15	9.650	19.970	2.07				12.6
A 16	A 17	8.240	19.320	2.34				11.5
A 15	A 18	10.700	21.850	2.04				13.8
A 18	A 19	6.390	12.920	2.02				8.2
A 19	A 20	3.400	6.800	2.00				4.4
A 10	A 20	9.360	20.900	2.23				12.7
A 10	A 17	3.240	6.800	2.10				4.2
A 10	A 21	3.480	7.490	2.15				4.6
A 10	A 22	7.270	14.990	2.06				9.4
A 21	A 22	1.160	2.360	2.03				1.5
A 15	A 23	10.000	20.200	2.02				12.9
A 22	A 24	11.500	17.900	1.56				13.1

NO	NE	R	X	X/R	wC	wCcomp	wCset	Length
A 23	A 24	13.200	27.000	2.05				17.1
A 24	A 25	18.850	32.920	1.75				22.6
A 25	A 26	20.540	38.000	1.85				25.3
A 25	A 27	10.930	20.870	1.91				13.7
A 27	A 29	21.980	41.530	1.89				27.4
A 27	A 30	32.020	60.270	1.88				39.8
A 29	A 30	23.990	45.330	1.89				29.9
A 1	BUS 48	4.600	17.680	3.84	2.140	5.057	2.140	77.8
A 8	BUS 40	1.250	4.620	3.70	.480	1.351	.480	20.8
A 2	BUS 45	2.600	8.100	3.12	.820	2.620	2.620*	40.3
A 28	BUS 42	2.110	6.850	3.25	1.890	2.161	1.890	33.2
A 5	BUS 44	1.900	5.600	2.95	2.600	1.874	2.600	28.8
B 1	B 2	1.920	5.750	2.99	2.640	1.906	2.640	29.3
B 1	B 3	4.520	18.520	4.10	2.040	5.113	2.040	78.7
B 2	B 4	5.700	17.370	3.05	1.840	5.695	5.695*	87.6
B 3	B 4	1.320	3.790	2.87	.420	1.289	1.289*	19.8
B 2	B 5	4.720	19.830	4.20	2.090	5.401	2.090	83.1
B 2	B 6	5.810	17.630	3.03	1.870	5.795	5.795*	89.2
B 4	B 6	1.190	4.140	3.48	.450	1.254	.450	19.3
B 5	B 7	4.600	13.800	3.00	1.020	4.568	4.568*	70.3
B 6	B 7	2.670	8.200	3.07	.850	2.676	2.676*	41.2
B 6	B 8	1.200	4.200	3.50	.450	1.267	.450	19.5
B 6	B 28	1.690	5.990	3.54	.650	1.794	.650	27.6
B 8	B 28	6.360	20.000	3.14	2.140	6.432	2.140	99.0
B 9	B 11	.000	20.800					
B 9	B 10	.000	11.000					
B 12	B 13	.000	14.000					
B 12	B 14	12.310	25.590	2.08				16.1
B 12	B 15	6.620	13.040	1.97				8.4
B 12	B 16	9.450	19.870	2.10				12.4
B 14	B 15	9.650	19.970	2.07				12.6
B 16	B 17	8.240	19.320	2.34				11.5
B 15	B 18	10.700	21.850	2.04				13.8
B 18	B 19	6.390	12.920	2.02				8.2
B 19	B 20	3.400	6.800	2.00				4.4
B 10	B 20	9.360	20.900	2.23				12.7
B 10	B 17	3.240	6.800	2.10				4.2
B 10	B 21	3.480	7.490	2.15				4.6
B 10	B 22	7.270	14.990	2.06				9.4
B 21	B 22	1.160	2.360	2.03				1.5
B 15	B 23	10.000	20.200	2.02				12.9
B 22	B 24	11.500	17.900	1.56				13.1
B 23	B 24	13.200	27.000	2.05				17.1
B 24	B 25	18.850	32.920	1.75				22.6
B 25	B 26	20.540	38.000	1.85				25.3
B 25	B 27	10.930	20.870	1.91				13.7
B 27	B 29	21.980	41.530	1.89				27.4
B 27	B 30	32.020	60.270	1.88				39.8
B 29	B 30	23.990	45.330	1.89				29.9
B 1	BUS 20	1.300	4.800	3.69	.520	1.404	.520	21.6
B 4	BUS 21	2.500	8.200	3.28	.750	2.571	2.571*	39.6
B 8	BUS 22	2.300	7.900	3.43	.600	2.410	2.410*	37.1

NO	NE	R	X	X/R	wC	wCcomp	wCset	Length
B 28	BUS 32	4.800	17.800	3.71	2.150	5.195	2.150	79.9
C 1	C 2	1.920	5.750	2.99	2.640	1.906	2.640	29.3
C 1	C 3	4.520	18.520	4.10	2.040	5.113	2.040	78.7
C 2	C 4	5.700	17.370	3.05	1.840	5.695	5.695*	87.6
C 3	C 4	1.320	3.790	2.87	.420	1.289	1.289*	19.8
C 2	C 5	4.720	19.830	4.20	2.090	5.401	2.090	83.1
C 2	C 6	5.810	17.630	3.03	1.870	5.795	5.795*	89.2
C 4	C 6	1.190	4.140	3.48	.450	1.254	.450	19.3
C 5	C 7	4.600	13.800	3.00	1.020	4.568	4.568*	70.3
C 6	C 7	2.670	8.200	3.07	.850	2.676	2.676*	41.2
C 6	C 8	1.200	4.200	3.50	.450	1.267	.450	19.5
C 6	C 28	1.690	5.990	3.54	.650	1.794	.650	27.6
C 8	C 28	6.360	20.000	3.14	2.140	6.432	2.140	99.0
C 9	C 11	.000	20.800					
C 9	C 10	.000	11.000					
C 12	C 13	.000	14.000					
C 12	C 14	12.310	25.590	2.08				16.1
C 12	C 15	6.620	13.040	1.97				8.4
C 12	C 16	9.450	19.870	2.10				12.4
C 14	C 15	9.650	19.970	2.07				12.6
C 16	C 17	8.240	19.320	2.34				11.5
C 15	C 18	10.700	21.850	2.04				13.8
C 18	C 19	6.390	12.920	2.02				8.2
C 19	C 20	3.400	6.800	2.00				4.4
C 10	C 20	9.360	20.900	2.23				12.7
C 10	C 17	3.240	6.800	2.10				4.2
C 10	C 21	3.480	7.490	2.15				4.6
C 10	C 22	7.270	14.990	2.06				9.4
C 21	C 22	1.160	2.360	2.03				1.5
C 15	C 23	10.000	20.200	2.02				12.9
C 22	C 24	11.500	17.900	1.56				13.1
C 23	C 24	13.200	27.000	2.05				17.1
C 24	C 25	18.850	32.920	1.75				22.6
C 25	C 26	20.540	38.000	1.85				25.3
C 25	C 27	10.930	20.870	1.91				13.7
C 27	C 29	21.980	41.530	1.89				27.4
C 27	C 30	32.020	60.270	1.88				39.8
C 29	C 30	23.990	45.330	1.89				29.9
C 28	BUS 82	1.250	4.580	3.66	.450	1.346	.450	20.7
C 8	BUS 83	1.300	4.650	3.58	.520	1.385	.520	21.3
C 5	BUS 85	1.500	4.820	3.21	.550	1.530	.550	23.5
C 2	BUS 89	4.600	17.200	3.74	2.150	4.996	2.150	76.9
C 1	BUS 92	2.000	7.200	3.60	1.160	2.137	1.160	32.9
C 4	BUS 95	1.800	6.200	3.44	.950	1.888	.950	29.1
D 1	D 2	1.920	5.750	2.99	2.640	1.906	2.640	29.3
D 1	D 3	4.520	18.520	4.10	2.040	5.113	2.040	78.7
D 2	D 4	5.700	17.370	3.05	1.840	5.695	5.695*	87.6
D 3	D 4	1.320	3.790	2.87	.420	1.289	1.289*	19.8
D 2	D 5	4.720	19.830	4.20	2.090	5.401	2.090	83.1
D 2	D 6	5.810	17.630	3.03	1.870	5.795	5.795*	89.2
D 4	D 6	1.190	4.140	3.48	.450	1.254	.450	19.3
D 5	D 7	4.600	13.800	3.00	1.020	4.568	4.568*	70.3

NO	NE	R	X	X/R	wC	wCcomp	wCset	Length
E 2	BUS 97	2.200	8.000	3.64	1.200	2.361	1.200	36.3
E 5	BUS 90	2.300	7.500	3.26	1.150	2.360	1.150	36.3

Appendix G

250 Bus Network

FDLF Based Results

Low Load Case

G.1 Transmission Line Data
Transformer Data
Shunt Element Data

G.2 Bus Oriented Results

G.3 Line Flow Results

Sbase: 100.

Transmission Lines

NO	NE	R %	X %	X/R	wC*Sbase	Length
BUS 1	BUS 2	3.030	9.990	3.30	2.540	48.0
BUS 1	BUS 3	1.290	4.240	3.29	1.082	20.4
BUS 4	BUS 5	.176	.798	4.53	.210	3.2
BUS 3	BUS 5	2.410	10.800	4.48	2.840	43.7
BUS 5	BUS 6	1.190	5.400	4.54	1.426	21.7
BUS 6	BUS 7	.459	2.080	4.53	.550	8.4
BUS 8	BUS 9	.244	3.050	12.50	48.536	90.5
BUS 9	BUS 10	.258	3.220	12.48	51.278	95.6
BUS 4	BUS 11	2.090	6.880	3.29	1.748	33.1
BUS 5	BUS 11	2.030	6.820	3.36	1.738	32.4
BUS 11	BUS 12	.595	1.960	3.29	.502	9.4
BUS 2	BUS 12	1.870	6.160	3.29	1.572	29.6
BUS 3	BUS 12	4.840	16.000	3.31	4.060	76.8
BUS 7	BUS 12	.862	3.400	3.94	.874	14.7
BUS 11	BUS 13	2.225	7.310	3.29	1.876	35.2
BUS 12	BUS 14	2.150	7.070	3.29	1.816	34.0
BUS 13	BUS 15	7.440	24.440	3.28	6.268	117.8
BUS 14	BUS 15	5.950	19.500	3.28	5.020	94.1
BUS 12	BUS 16	2.120	8.340	3.93	2.140	36.2
BUS 15	BUS 17	1.320	4.370	3.31	1.363	21.0
BUS 16	BUS 17	4.540	18.010	3.97	4.660	77.9
BUS 17	BUS 18	1.230	5.050	4.11	1.298	21.4
BUS 18	BUS 19	1.190	4.930	4.14	1.142	20.8
BUS 19	BUS 20	2.520	11.700	4.64	2.980	46.5
BUS 15	BUS 19	1.200	3.940	3.28	1.010	19.0
BUS 20	BUS 21	1.830	8.490	4.64	2.160	33.8
BUS 21	BUS 22	2.090	9.700	4.64	2.460	38.6
BUS 22	BUS 23	3.420	15.900	4.65	4.040	63.2
BUS 23	BUS 24	1.350	4.920	3.64	1.450	22.3
BUS 23	BUS 25	1.560	8.000	5.13	1.967	30.3
BUS 25	BUS 27	3.180	16.300	5.13	4.009	61.7
BUS 27	BUS 28	1.913	8.550	4.47	2.160	34.7
BUS 28	BUS 29	2.370	9.430	3.98	2.380	40.7
BUS 8	BUS 30	.431	5.040	11.69	51.400	154.3
BUS 26	BUS 30	.799	8.600	10.76	90.800	274.2
BUS 17	BUS 31	4.740	15.630	3.30	3.990	75.2
BUS 29	BUS 31	1.080	3.310	3.06	.830	16.6
BUS 23	BUS 32	3.170	11.530	3.64	3.402	52.3
BUS 31	BUS 32	2.980	9.850	3.31	2.510	47.3
BUS 27	BUS 32	2.290	7.550	3.30	1.926	36.3
BUS 15	BUS 33	3.800	12.440	3.27	3.194	60.1
BUS 19	BUS 34	7.520	24.700	3.28	6.320	119.0
BUS 35	BUS 36	.224	1.020	4.55	.268	4.1
BUS 35	BUS 37	1.100	4.970	4.52	1.318	20.0
BUS 33	BUS 37	4.150	14.200	3.42	3.660	66.8
BUS 34	BUS 36	.871	2.680	3.08	.568	13.4
BUS 34	BUS 37	.256	.940	3.67	.276	4.2
BUS 37	BUS 39	3.210	10.600	3.30	2.700	50.9
BUS 37	BUS 40	5.930	16.800	2.83	4.200	88.7
BUS 30	BUS 38	.464	5.400	11.64	42.200	165.7
BUS 39	BUS 40	1.840	6.050	3.29	1.552	29.1

NO	NE	R %	X %	X/R	wC*Sbase	Length
BUS 40	BUS 41	1.450	4.780	3.30	1.222	23.0
BUS 40	BUS 42	5.550	18.300	3.30	4.660	88.0
BUS 41	BUS 42	4.100	13.500	3.29	3.440	65.0
BUS 43	BUS 44	6.080	24.540	4.04	6.068	105.1
BUS 34	BUS 43	4.130	16.810	4.07	4.226	71.7
BUS 44	BUS 45	2.240	9.010	4.02	2.240	38.7
BUS 45	BUS 46	4.000	13.560	3.39	3.320	64.1
BUS 46	BUS 47	3.800	12.700	3.34	3.160	60.6
BUS 46	BUS 48	6.010	18.900	3.14	4.720	93.5
BUS 47	BUS 49	1.910	6.250	3.27	1.604	30.2
BUS 42	BUS 49	7.150	32.300	4.52	8.600	130.3
BUS 42	BUS 49	7.150	32.300	4.52	8.600	130.3
BUS 45	BUS 49	6.840	18.600	2.72	4.440	100.8
BUS 48	BUS 49	1.790	5.050	2.82	1.258	26.7
BUS 49	BUS 50	2.670	7.520	2.82	1.874	39.8
BUS 49	BUS 51	4.860	13.700	2.82	3.420	72.5
BUS 51	BUS 52	2.030	5.880	2.90	1.396	30.6
BUS 52	BUS 53	4.050	16.350	4.04	4.060	70.0
BUS 53	BUS 54	2.630	12.200	4.64	2.100	48.5
BUS 49	BUS 54	7.300	28.900	3.96	7.380	125.1
BUS 49	BUS 54	8.690	29.100	3.35	7.300	138.6
BUS 54	BUS 55	1.690	7.070	4.18	2.020	29.7
BUS 54	BUS 56	.275	.955	3.47	.289	4.5
BUS 55	BUS 56	.488	1.510	3.09	.374	7.5
BUS 56	BUS 57	3.430	9.660	2.82	2.420	51.2
BUS 50	BUS 57	4.740	13.400	2.83	3.320	70.8
BUS 56	BUS 58	3.430	9.660	2.82	2.420	51.2
BUS 51	BUS 58	2.550	7.190	2.82	1.788	38.1
BUS 54	BUS 59	5.030	22.930	4.56	5.980	92.0
BUS 56	BUS 59	8.250	25.100	3.04	5.690	126.7
BUS 56	BUS 59	8.030	23.900	2.98	5.360	122.3
BUS 55	BUS 59	4.739	21.580	4.55	5.646	86.7
BUS 59	BUS 60	3.170	14.500	4.57	3.760	58.1
BUS 59	BUS 61	3.280	15.000	4.57	3.880	60.1
BUS 60	BUS 61	.264	1.350	5.11	.332	5.1
BUS 60	BUS 62	1.230	5.610	4.56	1.468	22.5
BUS 61	BUS 62	.824	3.760	4.56	.980	15.1
BUS 63	BUS 64	.172	2.000	11.63	21.600	61.4
BUS 38	BUS 65	.901	9.860	10.94	104.600	311.8
BUS 64	BUS 65	.269	3.020	11.23	38.000	94.3
BUS 49	BUS 66	1.800	9.190	5.11	2.480	34.8
BUS 49	BUS 66	1.800	9.190	5.11	2.480	34.8
BUS 62	BUS 66	4.820	21.800	4.52	5.980	87.9
BUS 62	BUS 67	2.580	11.700	4.53	3.100	47.1
BUS 66	BUS 67	2.240	10.150	4.53	2.682	40.9
BUS 65	BUS 68	.138	1.600	11.59	26.378	49.2
BUS 47	BUS 69	8.440	27.780	3.29	7.092	133.7
BUS 49	BUS 69	9.850	32.400	3.29	8.280	156.0
BUS 69	BUS 70	3.000	12.700	4.23	3.445	53.0
BUS 24	BUS 70	10.221	41.150	4.03	10.200	176.5
BUS 70	BUS 71	.882	3.550	4.02	.880	15.2
BUS 24	BUS 72	4.880	19.600	4.02	4.880	84.2

NO	NE	R %	X %	X/R	wC*Sbase	Length
BUS 71	BUS 72	4.460	18.000	4.04	4.444	77.1
BUS 71	BUS 73	.866	4.540	5.24	1.180	17.0
BUS 70	BUS 74	4.010	13.230	3.30	3.368	63.6
BUS 70	BUS 75	4.280	14.100	3.29	3.600	67.8
BUS 69	BUS 75	4.050	12.200	3.01	4.028	62.0
BUS 74	BUS 75	1.230	4.060	3.30	1.034	19.5
BUS 76	BUS 77	4.440	14.800	3.33	3.680	70.7
BUS 69	BUS 77	3.090	10.100	3.27	3.173	48.8
BUS 75	BUS 77	6.010	19.990	3.33	5.000	95.6
BUS 77	BUS 78	.376	1.240	3.30	.388	6.0
BUS 78	BUS 79	.546	2.440	4.47	.648	9.9
BUS 77	BUS 80	1.700	4.850	2.85	1.657	25.5
BUS 77	BUS 80	2.940	10.500	3.57	2.280	48.2
BUS 79	BUS 80	1.560	7.040	4.51	1.870	28.4
BUS 68	BUS 81	.175	2.020	11.54	33.373	62.2
BUS 77	BUS 82	2.980	8.530	2.86	2.910	44.7
BUS 82	BUS 83	1.120	3.665	3.27	1.151	17.7
BUS 83	BUS 84	5.180	13.200	2.55	2.600	74.6
BUS 83	BUS 85	4.300	14.800	3.44	3.480	69.4
BUS 84	BUS 85	2.510	6.410	2.55	1.234	36.2
BUS 85	BUS 86	3.500	12.300	3.51	2.760	57.0
BUS 86	BUS 87	2.828	20.740	7.33	35.892	201.5
BUS 85	BUS 88	2.000	10.200	5.10	2.760	38.7
BUS 85	BUS 89	2.390	17.300	7.24	30.120	169.1
BUS 88	BUS 89	1.390	7.120	5.12	1.934	27.0
BUS 89	BUS 90	5.180	18.800	3.63	5.280	85.5
BUS 89	BUS 90	2.380	9.970	4.19	2.720	41.8
BUS 90	BUS 91	2.540	8.360	3.29	2.140	40.2
BUS 89	BUS 92	.990	5.050	5.10	1.245	19.2
BUS 89	BUS 92	3.930	15.810	4.02	4.140	67.8
BUS 91	BUS 92	3.870	12.720	3.29	3.268	61.3
BUS 92	BUS 93	2.580	8.480	3.29	2.180	40.9
BUS 92	BUS 94	4.810	15.800	3.28	4.060	76.1
BUS 93	BUS 94	2.230	7.320	3.28	1.876	35.3
BUS 94	BUS 95	1.320	4.340	3.29	1.110	20.9
BUS 80	BUS 96	3.560	18.200	5.11	4.940	69.0
BUS 82	BUS 96	1.620	5.300	3.27	1.664	25.6
BUS 94	BUS 96	2.690	8.690	3.23	2.300	42.3
BUS 80	BUS 97	1.830	9.340	5.10	2.540	35.4
BUS 80	BUS 98	2.380	10.800	4.54	2.860	43.5
BUS 80	BUS 99	4.540	20.600	4.54	5.460	82.9
BUS 92	BUS 100	6.480	29.500	4.55	7.720	118.5
BUS 94	BUS 100	1.780	5.800	3.26	1.826	28.1
BUS 95	BUS 96	1.710	5.470	3.20	1.474	26.8
BUS 96	BUS 97	1.730	8.850	5.12	2.400	33.5
BUS 98	BUS 100	3.970	17.900	4.51	4.760	72.3
BUS 99	BUS 100	1.800	8.130	4.52	1.646	32.8
BUS 100	BUS 101	2.770	12.620	4.56	3.280	50.7
BUS 92	BUS 102	1.230	5.590	4.54	1.464	22.5
BUS 101	BUS 102	2.460	11.200	4.55	2.940	45.0
BUS 100	BUS 103	1.600	5.250	3.28	1.646	25.3
BUS 100	BUS 104	4.510	20.400	4.52	5.510	82.2

NO	NE	R %	X %	X/R	wC*Sbase	Length
BUS 103	BUS 104	4.660	15.840	3.40	4.070	74.8
BUS 103	BUS 105	5.350	16.250	3.04	4.080	82.1
BUS 100	BUS 106	6.050	22.900	3.79	6.200	101.6
BUS 104	BUS 105	.994	3.780	3.80	.986	16.7
BUS 105	BUS 106	1.400	5.470	3.91	1.434	23.9
BUS 105	BUS 107	5.300	18.300	3.45	4.720	85.6
BUS 105	BUS 108	2.610	7.030	2.69	1.844	38.3
BUS 106	BUS 107	5.300	18.300	3.45	4.720	85.6
BUS 108	BUS 109	1.050	2.880	2.74	.760	15.5
BUS 103	BUS 110	3.906	18.130	4.64	4.710	72.1
BUS 109	BUS 110	2.780	7.620	2.74	2.020	41.1
BUS 110	BUS 111	2.200	7.550	3.43	2.000	35.5
BUS 110	BUS 112	2.470	6.400	2.59	2.326	35.8
BUS 17	BUS 113	.913	3.010	3.30	.768	14.5
BUS 32	BUS 113	6.150	20.300	3.30	5.180	97.5
BUS 32	BUS 114	1.350	6.120	4.53	1.626	24.6
BUS 27	BUS 115	1.640	7.410	4.52	1.972	29.9
BUS 114	BUS 115	.230	1.040	4.52	.276	4.2
BUS 68	BUS 116	.034	.405	11.91	6.592	12.3
BUS 12	BUS 117	3.290	14.000	4.26	3.580	58.3
BUS 75	BUS 118	1.450	4.810	3.32	1.200	23.0
BUS 76	BUS 118	1.640	5.440	3.32	1.356	26.1
A 1	A 2	1.920	5.750	2.99	2.640	29.3
A 1	A 3	4.520	18.520	4.10	2.040	78.7
A 2	A 4	5.700	17.370	3.05	5.695	87.6
A 3	A 4	1.320	3.790	2.87	1.289	19.8
A 2	A 5	4.720	19.830	4.20	2.090	83.1
A 2	A 6	5.810	17.630	3.03	5.795	89.2
A 4	A 6	1.190	4.140	3.48	.450	19.3
A 5	A 7	4.600	13.800	3.00	4.568	70.3
A 6	A 7	2.670	8.200	3.07	2.676	41.2
A 6	A 8	1.200	4.200	3.50	.450	19.5
A 6	A 28	1.690	5.990	3.54	.650	27.6
A 8	A 28	6.360	20.000	3.14	2.140	99.0
A 9	A 11	.000	20.800			
A 9	A 10	.000	11.000			
A 12	A 13	.000	14.000			
A 12	A 14	12.310	25.590	2.08		16.1
A 12	A 15	6.620	13.040	1.97		8.4
A 12	A 16	9.450	19.870	2.10		12.4
A 14	A 15	9.650	19.970	2.07		12.6
A 16	A 17	8.240	19.320	2.34		11.5
A 15	A 18	10.700	21.850	2.04		13.8
A 18	A 19	6.390	12.920	2.02		8.2
A 19	A 20	3.400	6.800	2.00		4.4
A 10	A 20	9.360	20.900	2.23		12.7
A 10	A 17	3.240	6.800	2.10		4.2
A 10	A 21	3.480	7.490	2.15		4.6
A 10	A 22	7.270	14.990	2.06		9.4
A 21	A 22	1.160	2.360	2.03		1.5
A 15	A 23	10.000	20.200	2.02		12.9
A 22	A 24	11.500	17.900	1.56		13.1

NO	NE	R %	X %	X/R	wC*Sbase	Length
A 23	A 24	13.200	27.000	2.05		17.1
A 24	A 25	18.850	32.920	1.75		22.6
A 25	A 26	20.540	38.000	1.85		25.3
A 25	A 27	10.930	20.870	1.91		13.7
A 27	A 29	21.980	41.530	1.89		27.4
A 27	A 30	32.020	60.270	1.88		39.8
A 29	A 30	23.990	45.330	1.89		29.9
A 1	BUS 48	4.600	17.680	3.84	2.140	77.8
A 8	BUS 40	1.250	4.620	3.70	.480	20.8
A 2	BUS 45	2.600	8.100	3.12	2.620	40.3
A 28	BUS 42	2.110	6.850	3.25	1.890	33.2
A 5	BUS 44	1.900	5.600	2.95	2.600	28.8
B 1	B 2	1.920	5.750	2.99	2.640	29.3
B 1	B 3	4.520	18.520	4.10	2.040	78.7
B 2	B 4	5.700	17.370	3.05	5.695	87.6
B 3	B 4	1.320	3.790	2.87	1.289	19.8
B 2	B 5	4.720	19.830	4.20	2.090	83.1
B 2	B 6	5.810	17.630	3.03	5.795	89.2
B 4	B 6	1.190	4.140	3.48	.450	19.3
B 5	B 7	4.600	13.800	3.00	4.568	70.3
B 6	B 7	2.670	8.200	3.07	2.676	41.2
B 6	B 8	1.200	4.200	3.50	.450	19.5
B 6	B 28	1.690	5.990	3.54	.650	27.6
B 8	B 28	6.360	20.000	3.14	2.140	99.0
B 9	B 11	.000	20.800			
B 9	B 10	.000	11.000			
B 12	B 13	.000	14.000			
B 12	B 14	12.310	25.590	2.08		16.1
B 12	B 15	6.620	13.040	1.97		8.4
B 12	B 16	9.450	19.870	2.10		12.4
B 14	B 15	9.650	19.970	2.07		12.6
B 16	B 17	8.240	19.320	2.34		11.5
B 15	B 18	10.700	21.850	2.04		13.8
B 18	B 19	6.390	12.920	2.02		8.2
B 19	B 20	3.400	6.800	2.00		4.4
B 10	B 20	9.360	20.900	2.23		12.7
B 10	B 17	3.240	6.800	2.10		4.2
B 10	B 21	3.480	7.490	2.15		4.6
B 10	B 22	7.270	14.990	2.06		9.4
B 21	B 22	1.160	2.360	2.03		1.5
B 15	B 23	10.000	20.200	2.02		12.9
B 22	B 24	11.500	17.900	1.56		13.1
B 23	B 24	13.200	27.000	2.05		17.1
B 24	B 25	18.850	32.920	1.75		22.6
B 25	B 26	20.540	38.000	1.85		25.3
B 25	B 27	10.930	20.870	1.91		13.7
B 27	B 29	21.980	41.530	1.89		27.4
B 27	B 30	32.020	60.270	1.88		39.8
B 29	B 30	23.990	45.330	1.89		29.9
B 1	BUS 20	1.300	4.800	3.69	.520	21.6
B 4	BUS 21	2.500	8.200	3.28	2.571	39.6
B 8	BUS 22	2.300	7.900	3.43	2.410	37.1

NO	NE	R %	X %	X/R	wC*Sbase	Length
B 28	BUS 32	4.800	17.800	3.71	2.150	79.9
C 1	C 2	1.920	5.750	2.99	2.640	29.3
C 1	C 3	4.520	18.520	4.10	2.040	78.7
C 2	C 4	5.700	17.370	3.05	5.695	87.6
C 3	C 4	1.320	3.790	2.87	1.289	19.8
C 2	C 5	4.720	19.830	4.20	2.090	83.1
C 2	C 6	5.810	17.630	3.03	5.795	89.2
C 4	C 6	1.190	4.140	3.48	.450	19.3
C 5	C 7	4.600	13.800	3.00	4.568	70.3
C 6	C 7	2.670	8.200	3.07	2.676	41.2
C 6	C 8	1.200	4.200	3.50	.450	19.5
C 6	C 28	1.690	5.990	3.54	.650	27.6
C 8	C 28	6.360	20.000	3.14	2.140	99.0
C 9	C 11	.000	20.800			
C 9	C 10	.000	11.000			
C 12	C 13	.000	14.000			
C 12	C 14	12.310	25.590	2.08		16.1
C 12	C 15	6.620	13.040	1.97		8.4
C 12	C 16	9.450	19.870	2.10		12.4
C 14	C 15	9.650	19.970	2.07		12.6
C 16	C 17	8.240	19.320	2.34		11.5
C 15	C 18	10.700	21.850	2.04		13.8
C 18	C 19	6.390	12.920	2.02		8.2
C 19	C 20	3.400	6.800	2.00		4.4
C 10	C 20	9.360	20.900	2.23		12.7
C 10	C 17	3.240	6.800	2.10		4.2
C 10	C 21	3.480	7.490	2.15		4.6
C 10	C 22	7.270	14.990	2.06		9.4
C 21	C 22	1.160	2.360	2.03		1.5
C 15	C 23	10.000	20.200	2.02		12.9
C 22	C 24	11.500	17.900	1.56		13.1
C 23	C 24	13.200	27.000	2.05		17.1
C 24	C 25	18.850	32.920	1.75		22.6
C 25	C 26	20.540	38.000	1.85		25.3
C 25	C 27	10.930	20.870	1.91		13.7
C 27	C 29	21.980	41.530	1.89		27.4
C 27	C 30	32.020	60.270	1.88		39.8
C 29	C 30	23.990	45.330	1.89		29.9
C 28	BUS 82	1.250	4.580	3.66	.450	20.7
C 8	BUS 83	1.300	4.650	3.58	.520	21.3
C 5	BUS 85	1.500	4.820	3.21	.550	23.5
C 2	BUS 89	4.600	17.200	3.74	2.150	76.9
C 1	BUS 92	2.000	7.200	3.60	1.160	32.9
C 4	BUS 95	1.800	6.200	3.44	.950	29.1
D 1	D 2	1.920	5.750	2.99	2.640	29.3
D 1	D 3	4.520	18.520	4.10	2.040	78.7
D 2	D 4	5.700	17.370	3.05	5.695	87.6
D 3	D 4	1.320	3.790	2.87	1.289	19.8
D 2	D 5	4.720	19.830	4.20	2.090	83.1
D 2	D 6	5.810	17.630	3.03	5.795	89.2
D 4	D 6	1.190	4.140	3.48	.450	19.3
D 5	D 7	4.600	13.800	3.00	4.568	70.3

NO	NE	R %	X %	X/R	wC*Sbase	Length
D 6	D 7	2.670	8.200	3.07	2.676	41.2
D 6	D 8	1.200	4.200	3.50	.450	19.5
D 6	D 28	1.690	5.990	3.54	.650	27.6
D 8	D 28	6.360	20.000	3.14	2.140	99.0
D 9	D 11	.000	20.800			
D 9	D 10	.000	11.000			
D 12	D 13	.000	14.000			
D 12	D 14	12.310	25.590	2.08		16.1
D 12	D 15	6.620	13.040	1.97		8.4
D 12	D 16	9.450	19.870	2.10		12.4
D 14	D 15	9.650	19.970	2.07		12.6
D 16	D 17	8.240	19.320	2.34		11.5
D 15	D 18	10.700	21.850	2.04		13.8
D 18	D 19	6.390	12.920	2.02		8.2
D 19	D 20	3.400	6.800	2.00		4.4
D 10	D 20	9.360	20.900	2.23		12.7
D 10	D 17	3.240	6.800	2.10		4.2
D 10	D 21	3.480	7.490	2.15		4.6
D 10	D 22	7.270	14.990	2.06		9.4
D 21	D 22	1.160	2.360	2.03		1.5
D 15	D 23	10.000	20.200	2.02		12.9
D 22	D 24	11.500	17.900	1.56		13.1
D 23	D 24	13.200	27.000	2.05		17.1
D 24	D 25	18.850	32.920	1.75		22.6
D 25	D 26	20.540	38.000	1.85		25.3
D 25	D 27	10.930	20.870	1.91		13.7
D 27	D 29	21.980	41.530	1.89		27.4
D 27	D 30	32.020	60.270	1.88		39.8
D 29	D 30	23.990	45.330	1.89		29.9
D 1	BUS 56	1.150	4.200	3.65	1.237	19.0
D 4	BUS 51	4.600	15.200	3.30	2.200	73.0
D 5	BUS 66	2.200	7.150	3.25	1.200	34.7
D 8	BUS 67	2.300	7.500	3.26	1.150	36.3
D 28	BUS 59	6.200	21.000	3.39	3.150	99.4
E 1	E 2	1.938	5.917	3.05	1.938	29.8
E 1	E 5	5.403	22.304	4.13	4.920	94.4
E 2	E 3	4.699	19.797	4.21	4.380	82.8
E 2	E 4	5.811	17.632	3.03	3.740	89.2
E 2	E 5	5.695	17.388	3.05	3.400	87.6
E 3	E 4	6.701	17.103	2.55	3.460	96.6
E 4	E 5	1.335	4.211	3.15	1.280	20.8
E 6	E 11	9.498	19.890	2.09		12.4
E 6	E 12	12.291	25.581	2.08		16.1
E 6	E 13	6.615	13.027	1.97		8.4
E 7	E 8	.000	17.615			
E 7	E 9	.000	11.001			
E 9	E 10	3.181	8.450	2.66		46.5
E 9	E 14	12.711	27.038	2.13		16.8
E 10	E 11	8.205	19.207	2.34		11.4
E 12	E 13	22.092	19.988	.90		20.5
E 13	E 14	17.093	34.802	2.04		22.1
E 1	BUS 102	1.100	4.100	3.73	.520	18.4

NO	NE	R %	X %	X/R	wC*Sbase	Length
E 2	BUS 97	2.200	8.000	3.64	1.200	36.3
E 5	BUS 90	2.300	7.500	3.26	1.150	36.3

Transformers

NO	NE	R %	X %	Tap
BUS 8	BUS 5	.000	2.670	.985
BUS 26	BUS 25	.000	3.820	.960
BUS 30	BUS 17	.000	3.880	.960
BUS 38	BUS 37	.000	3.750	.935
BUS 63	BUS 59	.000	3.860	.960
BUS 64	BUS 61	.000	2.680	.985
BUS 65	BUS 66	.000	3.700	.935
BUS 68	BUS 69	.000	3.700	.935
BUS 81	BUS 80	.000	3.700	.935
A 6	A 9	.000	20.800	.978
A 6	A 10	.000	55.600	.969
A 4	A 12	.000	25.600	.932
A 28	A 27	.000	39.600	.968
B 6	B 9	.000	20.800	.978
B 6	B 10	.000	55.600	.969
B 4	B 12	.000	25.600	.932
B 28	B 27	.000	39.600	.968
C 6	C 9	.000	20.800	.978
C 6	C 10	.000	55.600	.969
C 4	C 12	.000	25.600	.932
C 28	C 27	.000	39.600	.968
D 6	D 9	.000	20.800	.978
D 6	D 10	.000	55.600	.969
D 4	D 12	.000	25.600	.932
D 28	D 27	.000	39.600	.968
E 4	E 7	.000	20.912	.978
E 4	E 9	.000	55.618	.969
E 5	E 6	.000	25.202	.932

Shunt Elements

NO	wC*Sbase
BUS 5	-40.000
BUS 17	.000
BUS 34	14.000
BUS 37	-25.000
BUS 44	10.000
BUS 45	10.000
BUS 46	10.000
BUS 48	15.000
BUS 74	12.000
BUS 79	20.000
BUS 82	20.000
BUS 83	10.000
BUS 105	20.000
BUS 107	6.000
BUS 110	6.000
A 10	19.011
A 24	4.000
B 10	19.011
B 24	4.000
C 10	19.011
C 24	4.000
D 10	19.011
D 24	4.000
E 9	19.000

```
   Time for input:  3.27
   Time for compact:   .27
   Time for factorization:   .33
o. of iterations:  9.5
aximum mismatch (in pu):  8.7E-04 5.6E-04
   Time for solution:   .26
xecution time:  4.13

 base : 100.
```

Bus	Vsp	Voltage		Generation		QGmin	QGmax	Load	
US 69		1.035	30.00	209.39	-34.62				
US 1	.960	.960	17.96	.00	12.92	-5.00	35.00	51.00	27.00
US 4	.998	.998	23.49	50.00	-12.41	-300.00	300.00	30.00	12.00
US 6	.990	.990	20.38	.00	31.66	-13.00	50.00	52.00	22.00
US 8	1.015	1.015	29.19	40.00	144.92	-300.00	300.00	.00	10.00
US 10	1.055	1.055	44.10	450.00	34.26	-147.00	200.00	.00	.00
JS 12	.990	.990	19.64	85.00	112.26	-35.00	120.00	47.00	20.00
JS 15	.970	.970	18.42	.00	-5.43	-10.00	50.00	90.00	40.00
JS 18	.973	.973	18.75	.00	8.51	-16.00	50.00	60.00	34.00
JS 19	.960	.972+	18.07	.00	-8.00	-8.00	24.00	45.00	25.00
JS 24	.992	.992	29.37	49.00	-10.04	-300.00	300.00	.00	.00
JS 25	1.050	1.050	35.38	220.00	70.93	-47.00	140.00	.00	.00
JS 26	1.015	1.015	37.11	314.00	10.31	-1000.00	1000.00	.00	.00
JS 27	.968	.968	24.65	45.00	-9.91	-300.00	300.00	20.00	13.00
JS 31	.967	.967	20.57	7.00	40.49	-300.00	300.00	43.00	27.00
JS 32	.963	.963+	22.27	.00	-14.00	-14.00	42.00	59.00	23.00
JS 34	.984	.987+	17.30	.00	-8.00	-8.00	24.00	59.00	26.00
JS 36	.980	.980	16.91	.00	.70	-8.00	24.00	31.00	17.00
JS 40	.970	.970	13.80	-46.00	-34.74	-300.00	300.00	20.00	23.00
JS 42	.985	.985	14.08	-59.00	26.85	-300.00	300.00	37.00	23.00
JS 46	1.080	1.080	22.28	89.00	91.76	-100.00	100.00	28.00	10.00
JS 49	1.025	1.025	24.42	204.00	1.72	-85.00	210.00	87.00	30.00
JS 54	.970	.970	21.52	48.00	-19.94	-300.00	300.00	113.00	52.00
JS 55	.970	.970	21.30	.00	2.89	-8.00	23.00	63.00	22.00
JS 56	.970	.974+	21.62	.00	-7.78	-8.00	15.00	84.00	38.00
JS 59	.985	.985	23.68	155.00	42.26	-60.00	180.00	277.00	113.00
JS 61	.995	.995	27.15	160.00	-13.99	-100.00	300.00	.00	.00
S 62	.998	.998	26.11	.00	20.71	-20.00	30.00	77.00	24.00
S 65	1.005	1.005	30.31	391.00	102.43	-67.00	200.00	.00	.00
S 66	1.050	1.050	29.42	392.00	38.22	-67.00	200.00	39.00	18.00
S 70	.984	.984	26.95	.00	-9.13	-10.00	32.00	66.00	20.00
S 72	.980	.980	31.48	43.00	-23.80	-100.00	100.00	.00	.00
S 73	.991	.991	29.30	37.00	1.44	-100.00	100.00	.00	.00
S 74	.975	.975	24.18	.00	35.46	-6.00	39.00	68.00	27.00
S 76	.953	.953	24.61	.00	17.91	-8.00	53.00	68.00	37.00
S 77	1.006	1.006	30.61	.00	-8.39	-20.00	70.00	61.00	20.00
S 80	1.040	1.040	33.56	477.00	175.29	-165.00	280.00	130.00	56.00
S 85	1.020	1.020	36.58	.00	2.98	-8.00	23.00	24.00	15.00
S 87	1.015	1.015	35.83	4.00	-22.23	-100.00	1000.00	.00	.00
S 89	1.055	1.055	43.56	607.00	114.18	-210.00	300.00	.00	.00
S 90	.985	.985	37.19	-85.00	-13.94	-300.00	300.00	78.00	52.00
S 91	.985	.985	39.28	20.00	-44.66	-100.00	100.00	.00	.00
S 92	1.030	1.033+	39.96	.00	-3.00	-3.00	20.00	65.00	20.00
S 99	1.015	1.015	37.97	35.00	-24.67	-100.00	100.00	.00	.00
S 100	1.017	1.017	37.96	252.00	61.44	-50.00	155.00	37.00	18.00

BUS 103	1.000	1.000	36.42	40.00	35.04	-15.00	50.00	23.00	16.00
BUS 104	.971	.971	34.21	.00	20.10	-8.00	53.00	38.00	25.00
BUS 107	.952	.952	34.65	45.00	-4.54	-200.00	200.00	28.00	12.00
BUS 111	.980	.980	36.76	36.00	5.63	-100.00	1000.00	.00	.00
BUS 112	.975	.975	36.36	55.00	12.51	-100.00	1000.00	25.00	13.00
BUS 116	1.005	1.005	29.38	-184.00	104.09	-1000.00	1000.00	.00	.00
A 1	1.050	1.050	21.02	100.00	4.48	-100.00	100.00	.00	.00
A 2	1.045	1.045	18.73	80.00	78.45	-20.00	80.00	21.70	12.70
A 5	1.010	1.010	15.35	50.00	32.78	-15.00	62.45	94.20	39.00
A 8	1.000	.998-	14.02	20.00	85.00	-15.00	85.00	30.00	30.00
A 11	1.050	1.050	15.56	20.00	9.45	-10.00	45.83	.00	.00
A 13	1.050	1.050	13.84	20.00	6.05	-15.00	56.57	.00	.00
B 1	1.050	1.050	19.63	100.00	69.61	-100.00	100.00	.00	.00
B 2	1.045	1.045	18.99	80.00	42.75	-20.00	60.00	21.70	12.70
B 5	1.010	1.010	15.17	50.00	36.97	-15.00	62.45	94.20	39.00
B 8	1.010	1.010	17.65	20.00	63.91	-15.00	75.00	30.00	30.00
B 11	1.050	1.050	18.07	20.00	7.99	-10.00	45.83	.00	.00
B 13	1.050	1.050	16.00	20.00	5.45	-15.00	56.57	.00	.00
C 1	1.050	1.050	40.61	100.00	24.55	-100.00	100.00	.00	.00
C 2	1.045	1.045	39.59	80.00	38.16	-20.00	60.00	21.70	12.70
C 5	1.010	1.010	35.98	50.00	15.12	-15.00	62.45	94.20	39.00
C 8	1.010	1.010	34.08	20.00	43.63	-15.00	75.00	30.00	30.00
C 11	1.050	1.050	35.45	20.00	7.72	-10.00	45.83	.00	.00
C 13	1.050	1.050	33.71	20.00	5.10	-15.00	56.57	.00	.00
D 1	1.025	1.021-	23.96	100.00	100.00	-100.00	100.00	.00	.00
D 2	1.020	1.020	25.02	80.00	10.10	-20.00	60.00	21.70	12.70
D 5	1.010	1.010	26.41	50.00	-.96	-15.00	62.45	94.20	39.00
D 8	1.010	1.010	23.94	20.00	47.35	-15.00	75.00	30.00	30.00
D 11	1.050	1.050	23.98	20.00	9.28	-10.00	45.83	.00	.00
D 13	1.050	1.050	21.65	20.00	8.29	-15.00	56.57	.00	.00
E 1	1.060	1.060	39.84	250.00	83.57	-40.00	90.00	20.00	12.00
E 2	1.045	1.028-	35.54	40.00	50.00	-40.00	50.00	21.70	12.70
E 3	.970	.970	28.53	.00	31.81	.00	70.00	94.20	39.00
E 6	1.040	1.040	28.01	.00	15.95	-6.00	34.00	11.20	7.50
E 8	1.050	1.050	28.76	.00	15.83	-6.00	34.00	.00	.00

Bus	Voltage		Load	
IS 2	.973	18.60	20.00	9.00
IS 3	.967	18.92	50.00	20.00
IS 5	1.001	23.73	40.00	18.00
IS 7	.987	19.74	51.00	14.00
IS 9	1.034	36.55	.00	.00
IS 11	.985	20.38	70.00	23.00
IS 13	.968	18.91	34.00	16.00
IS 14	.981	18.90	14.00	5.00
IS 16	.984	19.30	25.00	10.00
S 17	.995	21.04	11.00	3.00
S 20	1.017	18.57	18.00	7.00
S 21	1.001	17.64	44.00	15.00
S 22	.994	18.97	45.00	13.00
S 23	.991	27.71	62.00	28.00
S 28	.960	22.36	17.00	7.00
S 29	.960	20.74	24.00	14.00
S 30	.985	26.06	.00	.00
S 33	.972	17.28	23.00	9.00
S 35	.980	16.92	33.00	19.00
S 37	.993	17.80	.00	.00
S 38	.964	22.74	.00	.00
S 39	.971	14.71	27.00	11.00
S 41	.967	13.13	37.00	10.00
S 43	.991	15.81	18.00	7.00
S 44	1.013	16.15	16.00	8.00
S 45	1.022	18.41	83.00	45.00
S 47	1.026	23.40	64.00	30.00
S 48	1.039	22.97	20.00	11.00
S 50	1.007	23.07	17.00	4.00
S 51	.986	21.82	17.00	8.00
S 52	.975	21.02	18.00	5.00
S 53	.962	20.40	23.00	11.00
S 57	.985	21.84	12.00	3.00
S 58	.978	21.45	12.00	3.00
S 60	.989	26.31	78.00	43.00
S 63	.970	26.33	.00	.00
S 64	.984	27.69	.00	.00
S 67	1.016	25.80	28.00	7.00
S 68	1.001	29.82	.00	.00
S 71	.987	28.32	.00	.00
S 75	.972	25.15	80.00	25.00
S 78	1.003	30.40	71.00	26.00
S 79	1.009	30.86	39.00	32.00
S 81	.993	31.26	.00	.00
S 82	1.003	33.01	54.00	27.00
S 83	1.008	33.87	20.00	10.00
S 84	1.012	35.49	11.00	7.00
S 86	1.022	35.31	21.00	10.00
S 88	1.026	39.77	48.00	25.00
S 93	1.015	37.84	12.00	7.00
S 94	1.008	36.39	30.00	16.00
S 95	1.000	35.12	42.00	31.00
S 96	1.006	34.11	38.00	15.00
S 97	1.021	34.24	15.00	9.00
S 98	.990	33.14	64.00	48.00
S 101	1.020	38.07	22.00	15.00

BUS 102	1.042	39.34	25.00	3.00
BUS 105	.960	33.81	31.00	34.00
BUS 106	.948	33.29	69.00	36.00
BUS 108	.954	33.46	2.00	1.00
BUS 109	.952	33.36	48.00	10.00
BUS 110	.967	35.20	39.00	25.10
BUS 113	.993	21.06	6.00	-6.40
BUS 114	.957	22.21	20.00	3.00
BUS 115	.957	22.32	35.00	10.00
BUS 117	.974	18.09	20.00	8.00
BUS 118	.957	24.44	33.00	15.00
3	1.015	16.65	2.40	1.20
4	1.008	15.79	7.60	1.60
6	1.002	14.79	.00	.00
7	.997	14.40	22.80	10.90
9	1.032	13.36	.00	.00
10	1.028	11.42	5.80	2.00
12	1.042	12.37	11.20	7.50
14	1.026	11.43	6.20	1.60
15	1.022	11.28	8.20	2.50
16	1.029	11.71	3.50	1.80
17	1.023	11.32	9.00	5.80
18	1.011	10.61	3.20	.90
19	1.009	10.41	9.50	3.40
20	1.012	10.60	2.20	.70
21	1.015	10.93	17.50	11.20
22	1.015	10.93	.00	.00
23	1.010	10.76	3.20	1.60
24	1.002	10.43	8.70	6.70
25	.994	10.41	.00	.00
26	.978	9.90	3.50	2.30
27	.999	10.66	.00	.00
28	.992	14.16	.00	.00
29	.975	9.47	2.40	.90
30	.959	8.65	10.60	3.90
3	1.017	17.83	2.40	1.20
4	1.010	17.52	7.60	1.60
6	1.008	17.36	.00	.00
7	1.001	15.95	22.80	10.90
9	1.035	15.88	.00	.00
10	1.031	13.91	5.80	2.00
12	1.043	14.53	11.20	7.50
14	1.027	13.66	6.20	1.60
15	1.023	13.56	8.20	2.50
16	1.031	14.01	3.50	1.80
17	1.026	13.76	9.00	5.80
18	1.014	12.97	3.20	.90
19	1.011	12.81	9.50	3.40
20	1.015	13.03	2.20	.70
21	1.018	13.45	17.50	11.20
22	1.018	13.46	.00	.00
23	1.012	13.20	3.20	1.60
24	1.005	13.08	8.70	6.70
25	.999	13.54	.00	.00
26	.983	13.04	3.50	2.30
27	1.004	14.10	.00	.00
28	.995	18.05	.00	.00
29	.980	12.92	2.40	.90
30	.965	12.11	10.60	3.90
3	1.016	36.43	2.40	1.20

4	1.008	35.61	7.60	1.60
6	1.008	34.72	.00	.00
7	1.001	34.59	22.80	10.90
9	1.035	33.26	.00	.00
10	1.031	31.31	5.80	2.00
12	1.044	32.25	11.20	7.50
14	1.027	31.31	6.20	1.60
15	1.024	31.15	8.20	2.50
16	1.031	31.59	3.50	1.80
17	1.026	31.21	9.00	5.80
18	1.014	30.49	3.20	.90
19	1.012	30.30	9.50	3.40
20	1.016	30.49	2.20	.70
21	1.019	30.81	17.50	11.20
22	1.019	30.81	.00	.00
23	1.013	30.62	3.20	1.60
24	1.006	30.25	8.70	6.70
25	1.001	30.08	.00	.00
26	.985	29.58	3.50	2.30
27	1.007	30.24	.00	.00
28	1.003	33.61	.00	.00
29	.983	29.07	2.40	.90
30	.968	28.26	10.60	3.90
3	1.003	23.15	2.40	1.20
4	.999	23.06	7.60	1.60
6	1.003	23.41	.00	.00
7	.997	23.94	22.80	10.90
9	1.032	21.78	.00	.00
10	1.028	19.73	5.80	2.00
12	1.039	20.18	11.20	7.50
14	1.023	19.32	6.20	1.60
15	1.020	19.22	8.20	2.50
16	1.028	19.73	3.50	1.80
17	1.023	19.56	9.00	5.80
18	1.010	18.68	3.20	.90
19	1.008	18.56	9.50	3.40
20	1.012	18.79	2.20	.70
21	1.015	19.24	17.50	11.20
22	1.016	19.25	.00	.00
23	1.009	18.87	3.20	1.60
24	1.003	18.75	8.70	6.70
25	.998	19.00	.00	.00
26	.982	18.50	3.50	2.30
27	1.004	19.43	.00	.00
28	.997	23.22	.00	.00
29	.980	18.25	2.40	.90
30	.964	17.43	10.60	3.90
4	.982	31.92	47.80	20.00
5	.990	34.01	7.60	1.60
7	1.023	28.76	.00	.00
9	1.018	27.13	29.50	16.60
10	1.014	26.98	9.00	5.80
11	1.023	27.36	3.50	1.80
12	1.024	27.09	6.10	1.60
13	1.019	27.00	13.50	5.80
14	1.000	26.00	14.90	5.00

Power Generated:	5635.39	1995.04
Power Demanded:	5481.60	2579.90
System Losses:	153.79	-584.86

Printout time: 1.42

BUS 69	BUS 47	41.90	-10.52
BUS 69	BUS 49	30.47	-8.95
BUS 69	BUS 70	49.92	29.06
BUS 69	BUS 75	79.57	27.68
BUS 69	BUS 77	-1.76	28.61
BUS 69	BUS 68	9.29	-100.50
Total:		209.39	-34.62

BUS 1	BUS 2	-13.12	-9.91
BUS 1	BUS 3	-37.88	-4.17
Total:		-51.00	-14.08

BUS 4	BUS 5	-56.93	-21.58
BUS 4	BUS 11	76.93	-2.83
Total:		20.00	-24.41

BUS 6	BUS 5	-105.67	6.05
BUS 6	BUS 7	53.67	3.61
Total:		-52.00	9.66

BUS 8	BUS 9	-440.62	-23.93
BUS 8	BUS 30	113.00	26.59
BUS 8	BUS 5	367.61	132.26
Total:		40.00	134.92

BUS 10	BUS 9	450.00	34.26
Total:		450.00	34.26

BUS 12	BUS 11	-51.54	42.63
BUS 12	BUS 2	33.47	16.17
BUS 12	BUS 3	10.85	9.10
BUS 12	BUS 7	-2.52	9.65
BUS 12	BUS 14	19.45	5.27
BUS 12	BUS 16	8.13	4.24
BUS 12	BUS 117	20.15	5.20
Total:		38.00	92.26

BUS 15	BUS 13	-2.74	-1.29
BUS 15	BUS 14	-5.33	-6.42
BUS 15	BUS 17	-107.17	-21.06
BUS 15	BUS 19	11.76	-9.68
BUS 15	BUS 33	13.48	-6.98
Total:		-90.00	-45.43

BUS 18	BUS 17	-81.74	-21.21
BUS 18	BUS 19	21.74	-4.28
Total:		-60.00	-25.49

BUS 19	BUS 18	-21.68	3.45
BUS 19	BUS 20	-14.75	-35.51
BUS 19	BUS 15	-11.73	8.82
BUS 19	BUS 34	3.16	-9.76
Total:		-45.00	-33.00

BUS 24	BUS 23	54.71	-12.60
BUS 24	BUS 70	9.94	-5.35
BUS 24	BUS 72	-15.65	7.90
Total:		49.00	-10.04

BUS 25	BUS 23	183.93	52.29
BUS 25	BUS 27	123.83	37.36
BUS 25	BUS 26	-87.76	-18.72
Total:		220.00	70.93

BUS 26	BUS 30	226.24	-11.20
BUS 26	BUS 25	87.76	21.51
Total:		314.00	10.31

BUS 27	BUS 25	-118.95	-16.46
BUS 27	BUS 28	43.44	-.88
BUS 27	BUS 32	48.80	-8.86
BUS 27	BUS 115	51.71	3.29
Total:		25.00	-22.91

BUS 31	BUS 17	-9.46	-16.19
BUS 31	BUS 29	-1.82	19.51
BUS 31	BUS 32	-24.72	10.17
Total:		-36.00	13.49

BUS 32	BUS 23	-77.87	.68
BUS 32	BUS 31	24.95	-11.73
BUS 32	BUS 27	-48.21	9.03
BUS 32	BUS 113	5.29	-17.78
BUS 32	BUS 114	3.79	8.36
BUS 32	B 28	33.05	-25.56
Total:		-59.00	-37.00

BUS 34	BUS 19	-3.11	3.84
BUS 34	BUS 36	30.04	16.43
BUS 34	BUS 37	-99.70	-33.05
BUS 34	BUS 43	13.77	-7.57
BUS 34	BUS 34	.00	-13.64
Total:		-59.00	-34.00

BUS 36	BUS 35	-1.07	.36
BUS 36	BUS 34	-29.93	-16.65
Total:		-31.00	-16.30

BUS 40	BUS 37	-39.27	.05
BUS 40	BUS 39	-23.00	4.98
BUS 40	BUS 41	22.85	-1.05
BUS 40	BUS 42	-4.49	-8.78
BUS 40	A 8	-22.08	-52.95
Total:		-66.00	-57.74

BUS 42	BUS 40	4.53	4.45
BUS 42	BUS 41	14.36	7.29
BUS 42	BUS 49	-55.00	.88
BUS 42	BUS 49	-55.00	.88
BUS 42	A 28	-4.88	-9.65
Total:		-96.00	3.85

BUS 46	BUS 45	63.54	27.40
BUS 46	BUS 47	-2.85	45.38
BUS 46	BUS 48	.31	20.64
BUS 46	BUS 46	.00	-11.66
Total:		61.00	81.76

BUS 49	BUS 47	27.24	-9.99
BUS 49	BUS 42	57.25	.58
BUS 49	BUS 42	57.25	.58
BUS 49	BUS 45	53.44	-17.22
BUS 49	BUS 48	38.70	-42.05
BUS 49	BUS 50	36.62	11.07
BUS 49	BUS 51	39.21	14.56
BUS 49	BUS 54	21.12	10.74
BUS 49	BUS 54	21.32	9.61
BUS 49	BUS 66	-102.77	-4.59
BUS 49	BUS 66	-102.77	-4.59
BUS 49	BUS 69	-29.59	3.04
Total:		117.00	-28.27

BUS 54	BUS 53	15.48	1.86
BUS 54	BUS 49	-20.66	-16.27
BUS 54	BUS 49	-20.79	-15.12

BUS 54	BUS 55	4.77	-2.08
BUS 54	BUS 56	-27.49	-34.92
BUS 54	BUS 59	-16.29	-5.29
Total:		-64.99	-71.82

BUS 55	BUS 54	-4.76	.20
BUS 55	BUS 56	-39.34	-14.38
BUS 55	BUS 59	-18.90	-4.87
Total:		-63.00	-19.05

BUS 56	BUS 54	27.55	34.85
BUS 56	BUS 55	39.43	14.31
BUS 56	BUS 57	-6.98	-9.81
BUS 56	BUS 58	1.22	-5.90
BUS 56	BUS 59	-13.60	-2.17
BUS 56	BUS 59	-14.25	-1.89
BUS 56	D 1	-117.37	-75.38
Total:		-84.00	-46.00

BUS 59	BUS 54	16.44	.23
BUS 59	BUS 56	13.76	-2.80
BUS 59	BUS 56	14.42	-2.74
BUS 59	BUS 55	19.08	.30
BUS 59	BUS 60	-29.87	2.64
BUS 59	BUS 61	-38.87	1.25
BUS 59	D 28	1.95	-7.86
BUS 59	BUS 63	-118.92	-61.77
Total:		-122.00	-70.74

BUS 61	BUS 59	39.38	-2.70
BUS 61	BUS 60	111.23	22.47
BUS 61	BUS 62	44.37	-17.71
BUS 61	BUS 64	-34.98	-16.04
Total:		160.00	-13.99

BUS 62	BUS 60	-2.69	15.73
BUS 62	BUS 61	-44.18	17.60
BUS 62	BUS 66	-31.34	-19.05
BUS 62	BUS 67	1.21	-17.56
Total:		-77.00	-3.29

BUS 65	BUS 38	132.93	-14.45
BUS 65	BUS 64	154.96	39.07
BUS 65	BUS 68	55.64	5.20
BUS 65	BUS 66	47.48	72.61
Total:		391.00	102.43

BUS 66	BUS 49	104.59	11.17
BUS 66	BUS 49	104.59	11.17
BUS 66	BUS 62	31.94	15.49
BUS 66	BUS 67	71.16	19.60
BUS 66	D 5	88.21	32.98
BUS 66	BUS 65	-47.48	-70.20
Total:		353.00	20.22

BUS 70	BUS 69	-48.95	-28.49
BUS 70	BUS 24	-9.84	-4.20
BUS 70	BUS 71	-63.30	7.80
BUS 70	BUS 74	34.20	-4.45
BUS 70	BUS 75	21.89	.20
Total:		-66.00	-29.13

BUS 72	BUS 24	15.82	-11.95
BUS 72	BUS 71	27.18	-11.86
Total:		43.00	-23.80

BUS 73	BUS 71	37.00	1.44
Total:		37.00	1.44

BUS 74	BUS 70	-33.71	2.83
BUS 74	BUS 75	-34.29	17.04
BUS 74	BUS 74	.00	-11.41
Total:		-68.00	8.46

BUS 76	BUS 77	-70.59	-11.07
BUS 76	BUS 118	2.59	-8.02
Total:		-68.00	-19.09

BUS 77	BUS 76	73.07	15.80
BUS 77	BUS 69	2.02	-31.05
BUS 77	BUS 75	47.99	2.29
BUS 77	BUS 78	34.17	10.40
BUS 77	BUS 80	-119.87	-26.49
BUS 77	BUS 80	-55.61	-16.84
BUS 77	BUS 82	-42.76	17.51
Total:		-61.00	-28.39

BUS 80	BUS 77	122.39	31.96
BUS 80	BUS 77	56.58	17.92
BUS 80	BUS 79	76.95	29.21
BUS 80	BUS 96	-1.62	17.10
BUS 80	BUS 97	-9.00	21.30

BUS 80	BUS 98	16.73	42.72
BUS 80	BUS 99	-34.61	18.81
BUS 80	BUS 81	119.57	-59.74
Total:		347.00	119.29
BUS 85	BUS 83	32.84	-2.13
BUS 85	BUS 84	31.31	.51
BUS 85	BUS 86	17.12	-7.41
BUS 85	BUS 88	-55.62	5.48
BUS 85	BUS 89	-76.34	-21.15
BUS 85	C 5	26.70	12.69
Total:		-24.00	-12.02
BUS 87	BUS 86	4.00	-22.23
Total:		4.00	-22.23
BUS 89	BUS 85	77.69	-1.54
BUS 89	BUS 88	105.71	25.21
BUS 89	BUS 90	67.96	21.03
BUS 89	BUS 90	127.64	48.53
BUS 89	BUS 92	140.06	23.08
BUS 89	BUS 92	44.56	2.98
BUS 89	C 2	43.37	-5.12
Total:		607.00	114.18
BUS 90	BUS 89	-65.54	-17.76
BUS 90	BUS 89	-123.62	-34.52
BUS 90	BUS 91	-38.54	11.44
BUS 90	E 5	64.70	-25.09
Total:		-163.00	-65.94
BUS 91	BUS 90	38.97	-12.10
BUS 91	BUS 92	-18.97	-32.55
Total:		20.00	-44.66
BUS 92	BUS 89	-138.27	-15.28
BUS 92	BUS 89	-43.85	-4.63
BUS 92	BUS 91	19.49	30.95
BUS 92	BUS 93	48.04	6.04
BUS 92	BUS 94	42.48	2.51
BUS 92	BUS 100	13.06	-1.34
BUS 92	BUS 102	16.17	-21.80
BUS 92	C 1	-22.12	-19.46
Total:		-65.00	-23.00
BUS 99	BUS 80	35.31	-21.40

BUS 99	BUS 100	-.31	-3.28
Total:		35.00	-24.67
BUS 100	BUS 92	-12.95	-6.28
BUS 100	BUS 94	49.08	1.26
BUS 100	BUS 98	48.69	3.94
BUS 100	BUS 99	.31	1.58
BUS 100	BUS 101	-2.15	-4.02
BUS 100	BUS 103	56.86	15.45
BUS 100	BUS 104	35.24	13.33
BUS 100	BUS 106	39.92	18.18
Total:		215.00	43.44
BUS 103	BUS 100	-56.32	-15.34
BUS 103	BUS 104	26.88	8.82
BUS 103	BUS 105	31.81	12.85
BUS 103	BUS 110	14.63	12.71
Total:		17.00	19.04
BUS 104	BUS 100	-34.58	-15.81
BUS 104	BUS 103	-26.49	-11.44
BUS 104	BUS 105	23.07	22.36
Total:		-38.00	-4.90
BUS 107	BUS 105	5.66	-7.77
BUS 107	BUS 106	11.34	-3.33
BUS 107	BUS 107	.00	-5.44
Total:		17.00	-16.54
BUS 111	BUS 110	36.00	5.63
Total:		36.00	5.63
BUS 112	BUS 110	30.00	-.49
Total:		30.00	-.49
BUS 116	BUS 68	-184.00	104.09
Total:		-184.00	104.09
A 1	A 2	71.73	-14.76
A 1	A 3	46.25	8.83
A 1	BUS 48	-17.98	10.41
Total:		100.00	4.48

A 2	A 1	-70.81	14.64
A 2	A 4	34.97	8.77
A 2	A 5	34.05	10.12
A 2	A 6	44.82	8.80
A 2	BUS 45	15.26	23.42
	Total:	58.30	65.75

A 5	A 2	-33.49	-9.99
A 5	A 7	13.73	2.39
A 5	BUS 44	-24.43	1.39
	Total:	-44.20	-6.22

A 8	A 6	-32.20	-1.04
A 8	A 28	-.32	1.95
A 8	BUS 40	22.52	54.09
	Total:	-10.00	55.00

A 11	A 9	20.00	9.45
	Total:	20.00	9.45

A 13	A 12	20.00	6.05
	Total:	20.00	6.05

B 1	B 2	22.05	.43
B 1	B 3	21.52	12.63
B 1	BUS 20	56.43	56.55
	Total:	100.00	69.61

B 2	B 1	-21.97	-3.07
B 2	B 4	20.37	11.68
B 2	B 5	37.96	9.45
B 2	B 6	21.94	12.00
	Total:	58.30	30.05

B 5	B 2	-37.29	-8.84
B 5	B 7	-6.91	6.81
	Total:	-44.20	-2.03

B 8	B 6	12.62	1.91
B 8	B 28	-1.02	6.77
B 8	BUS 22	-21.60	25.23
	Total:	-10.00	33.91

B 11	B 9	20.00	7.99
	Total:	20.00	7.99
B 13	B 12	20.00	5.45
	Total:	20.00	5.45
C 1	C 2	33.32	-3.15
C 1	C 3	44.40	8.93
C 1	BUS 92	22.28	18.77
	Total:	100.00	24.55
C 2	C 1	-33.13	.83
C 2	C 4	45.03	5.86
C 2	C 5	36.14	9.76
C 2	C 6	52.84	3.32
C 2	BUS 89	-42.59	5.68
	Total:	58.30	25.46
C 5	C 2	-35.52	-9.38
C 5	C 7	17.90	-1.65
C 5	BUS 85	-26.57	-12.84
	Total:	-44.20	-23.88
C 8	C 6	-23.82	10.78
C 8	C 28	4.77	.75
C 8	BUS 83	9.05	2.10
	Total:	-10.00	13.63
C 11	C 9	20.00	7.72
	Total:	20.00	7.72
C 13	C 12	20.00	5.10
	Total:	20.00	5.10
D 1	D 2	-29.36	10.79
D 1	D 3	9.65	6.49
D 1	BUS 56	119.71	82.72
	Total:	100.00	100.00
D 2	D 1	29.55	-12.99

D 2	D 4	21.83	2.31
D 2	D 5	-10.77	6.77
D 2	D 6	17.70	1.31
Total:		58.30	-2.60
D 5	D 2	10.85	-8.59
D 5	D 7	31.38	-2.90
D 5	BUS 66	-86.43	-28.48
Total:		-44.20	-39.96
D 8	D 6	25.11	9.90
D 8	D 28	7.65	2.93
D 8	BUS 67	-42.76	4.52
Total:		-10.00	17.35
D 11	D 9	20.00	9.28
Total:		20.00	9.28
D 13	D 12	20.00	8.29
Total:		20.00	8.29
E 1	E 2	143.14	14.31
E 1	E 5	53.36	19.97
E 1	BUS 102	33.50	37.29
Total:		230.00	71.57
E 2	E 1	-139.57	-5.51
E 2	E 3	65.81	16.02
E 2	E 4	41.01	12.54
E 2	E 5	20.89	14.06
E 2	BUS 97	30.15	.20
Total:		18.30	37.30
E 3	E 2	-63.74	-11.65
E 3	E 4	-30.46	4.46
Total:		-94.20	-7.19
E 6	E 11	8.34	4.75
E 6	E 12	7.96	2.65
E 6	E 13	18.30	7.87
E 6	E 5	-45.80	-6.82
Total:		-11.20	8.45

E 8	E 7	.00	15.83
	Total:	.00	15.83
BUS 2	BUS 1	13.21	7.80
BUS 2	BUS 12	-33.21	-16.80
	Total:	-20.00	-9.00
BUS 3	BUS 1	38.08	3.84
BUS 3	BUS 5	-77.35	-11.24
BUS 3	BUS 12	-10.73	-12.60
	Total:	-50.00	-20.00
BUS 5	BUS 4	56.99	21.66
BUS 5	BUS 3	78.92	15.52
BUS 5	BUS 6	107.03	-1.28
BUS 5	BUS 11	84.67	-.07
BUS 5	BUS 8	-367.61	-93.88
BUS 5	BUS 5	.00	40.06
	Total:	-40.00	-18.00
BUS 7	BUS 6	-53.53	-3.53
BUS 7	BUS 12	2.53	-10.47
	Total:	-51.00	-14.00
BUS 9	BUS 8	445.22	30.47
BUS 9	BUS 10	-445.22	-30.47
	Total:	.00	.00
BUS 11	BUS 4	-75.69	5.20
BUS 11	BUS 5	-83.22	3.24
BUS 11	BUS 12	51.81	-42.22
BUS 11	BUS 13	37.09	10.78
	Total:	-70.00	-23.00
BUS 13	BUS 11	-36.75	-11.43
BUS 13	BUS 15	2.75	-4.57
	Total:	-34.00	-16.00
BUS 14	BUS 12	-19.36	-6.73
BUS 14	BUS 15	5.36	1.73
	Total:	-14.00	-5.00

BUS 16	BUS 12	-8.11	-6.24
BUS 16	BUS 17	-16.89	-3.76
Total:		-25.00	-10.00
BUS 17	BUS 15	108.84	25.27
BUS 17	BUS 16	17.02	-.27
BUS 17	BUS 18	82.66	23.75
BUS 17	BUS 31	9.61	12.84
BUS 17	BUS 113	.89	6.26
BUS 17	BUS 30	-230.02	-70.85
BUS 17	BUS 17	.00	.00
Total:		-11.00	-3.00
BUS 20	BUS 19	15.11	34.27
BUS 20	BUS 21	22.56	13.04
BUS 20	B 1	-55.67	-54.31
Total:		-18.00	-7.00
BUS 21	BUS 20	-22.43	-14.66
BUS 21	BUS 22	-21.13	10.80
BUS 21	B 4	-.44	-11.14
Total:		-44.00	-15.00
BUS 22	BUS 21	21.25	-12.67
BUS 22	BUS 23	-88.11	26.42
BUS 22	B 8	21.86	-26.75
Total:		-45.00	-13.00
BUS 23	BUS 22	91.08	-16.62
BUS 23	BUS 24	-54.28	12.74
BUS 23	BUS 25	-178.74	-27.72
BUS 23	BUS 32	79.94	3.61
Total:		-62.00	-28.00
BUS 28	BUS 27	-43.06	.59
BUS 28	BUS 29	26.06	-7.59
Total:		-17.00	-7.00
BUS 29	BUS 28	-25.87	6.14
BUS 29	BUS 31	1.87	-20.14
Total:		-24.00	-14.00
BUS 30	BUS 8	-112.35	-70.39

BUS 30	BUS 26	-222.18	-35.86
BUS 30	BUS 38	104.50	12.70
BUS 30	BUS 17	230.02	93.56
Total:		.00	.00

BUS 33	BUS 15	-13.39	4.25
BUS 33	BUS 37	-9.61	-13.25
Total:		-23.00	-9.00

BUS 35	BUS 36	1.07	-.61
BUS 35	BUS 37	-34.07	-18.39
Total:		-33.00	-19.00

BUS 37	BUS 35	34.24	17.87
BUS 37	BUS 33	9.71	10.06
BUS 37	BUS 34	99.99	33.85
BUS 37	BUS 39	50.97	5.16
BUS 37	BUS 40	40.24	-1.33
BUS 37	BUS 38	-235.14	-90.24
BUS 37	BUS 37	.00	24.65
Total:		.00	.00

BUS 38	BUS 30	-103.93	-46.10
BUS 38	BUS 65	-131.22	-68.28
BUS 38	BUS 37	235.14	114.37
Total:		.00	.00

BUS 39	BUS 37	-50.11	-4.92
BUS 39	BUS 40	23.11	-6.08
Total:		-27.00	-11.00

BUS 41	BUS 40	-22.77	.16
BUS 41	BUS 42	-14.23	-10.16
Total:		-37.00	-10.00

BUS 43	BUS 44	-4.32	-10.82
BUS 43	BUS 34	-13.68	3.82
Total:		-18.00	-7.00

BUS 44	BUS 43	4.37	4.92
BUS 44	BUS 45	-44.91	1.06
BUS 44	A 5	24.54	-3.71
BUS 44	BUS 44	.00	-10.27
Total:		-16.00	-8.00

BUS 45	BUS 44	45.36	-1.60
BUS 45	BUS 46	-61.86	-25.38
BUS 45	BUS 49	-51.44	18.01
BUS 45	A 2	-15.06	-25.59
BUS 45	BUS 45	.00	-10.44
Total:		-83.00	-45.00

BUS 47	BUS 46	3.58	-46.45
BUS 47	BUS 49	-27.09	8.79
BUS 47	BUS 69	-40.48	7.66
Total:		-64.00	-30.00

BUS 48	BUS 46	-.03	-25.05
BUS 48	BUS 49	-38.15	42.25
BUS 48	A 1	18.17	-12.01
BUS 48	BUS 48	.00	-16.19
Total:		-20.00	-11.00

BUS 50	BUS 49	-36.25	-11.94
BUS 50	BUS 57	19.25	7.94
Total:		-17.00	-4.00

BUS 51	BUS 49	-38.38	-15.66
BUS 51	BUS 52	25.79	7.95
BUS 51	BUS 58	10.83	5.01
BUS 51	D 4	-15.24	-5.29
Total:		-17.00	-8.00

BUS 52	BUS 51	-25.63	-8.84
BUS 52	BUS 53	7.63	3.84
Total:		-18.00	-5.00

BUS 53	BUS 52	-7.59	-7.50
BUS 53	BUS 54	-15.41	-3.50
Total:		-23.00	-11.00

BUS 57	BUS 56	7.03	7.62
BUS 57	BUS 50	-19.03	-10.62
Total:		-12.00	-3.00

BUS 58	BUS 56	-1.21	3.62

BUS 58	BUS 51	-10.79	-6.62
Total:		-12.00	-3.00
BUS 60	BUS 59	30.17	-4.94
BUS 60	BUS 61	-110.89	-21.04
BUS 60	BUS 62	2.72	-17.02
Total:		-78.00	-43.00
BUS 63	BUS 64	-118.92	-68.91
BUS 63	BUS 59	118.92	68.91
Total:		.00	.00
BUS 64	BUS 63	119.25	52.03
BUS 64	BUS 65	-154.23	-68.47
BUS 64	BUS 61	34.98	16.44
Total:		.00	.00
BUS 67	BUS 62	-1.14	14.72
BUS 67	BUS 66	-70.04	-17.39
BUS 67	D 8	43.18	-4.33
Total:		-28.00	-7.00
BUS 68	BUS 65	-55.59	-31.20
BUS 68	BUS 81	-119.27	36.09
BUS 68	BUS 116	184.15	-108.91
BUS 68	BUS 69	-9.29	104.02
Total:		.00	.00
BUS 71	BUS 70	63.67	-7.17
BUS 71	BUS 72	-26.79	9.12
BUS 71	BUS 73	-36.88	-1.95
Total:		.00	.00
BUS 75	BUS 70	-21.68	-2.95
BUS 75	BUS 69	-76.84	-23.52
BUS 75	BUS 74	34.48	-17.38
BUS 75	BUS 77	-46.61	-2.59
BUS 75	BUS 118	30.64	21.43
Total:		-80.00	-25.00
BUS 78	BUS 77	-34.12	-10.64
BUS 78	BUS 79	-36.88	-15.36
Total:		-71.00	-26.00

BUS 79	BUS 78	36.97	15.09
BUS 79	BUS 80	-75.97	-26.72
BUS 79	BUS 79	.00	-20.37
Total:		-39.00	-32.00
BUS 81	BUS 68	119.57	-65.85
BUS 81	BUS 80	-119.57	65.85
Total:		.00	.00
BUS 82	BUS 77	43.41	-18.60
BUS 82	BUS 83	-41.10	.51
BUS 82	BUS 96	-34.72	5.30
BUS 82	C 28	-21.59	5.93
BUS 82	BUS 82	.00	-20.14
Total:		-54.00	-27.00
BUS 83	BUS 82	41.29	-1.06
BUS 83	BUS 84	-19.85	3.72
BUS 83	BUS 85	-32.39	.09
BUS 83	C 8	-9.04	-2.59
BUS 83	BUS 83	.00	-10.16
Total:		-20.00	-10.00
BUS 84	BUS 83	20.07	-5.82
BUS 84	BUS 85	-31.07	-1.18
Total:		-11.00	-7.00
BUS 86	BUS 85	-17.01	4.92
BUS 86	BUS 87	-3.99	-14.92
Total:		-21.00	-10.00
BUS 88	BUS 85	56.23	-5.28
BUS 88	BUS 89	-104.23	-19.72
Total:		-48.00	-25.00
BUS 93	BUS 92	-47.47	-6.45
BUS 93	BUS 94	35.47	-.55
Total:		-12.00	-7.00
BUS 94	BUS 92	-41.65	-4.03
BUS 94	BUS 93	-35.20	-.47
BUS 94	BUS 95	52.35	2.11

BUS 94	BUS 96	43.17	-11.83
BUS 94	BUS 100	-48.67	-1.78
Total:		-30.00	-16.00
BUS 95	BUS 94	-51.99	-2.05
BUS 95	BUS 96	26.39	-20.09
BUS 95	C 4	-16.40	-8.85
Total:		-42.00	-31.00
BUS 96	BUS 80	1.75	-21.61
BUS 96	BUS 82	34.92	-6.32
BUS 96	BUS 94	-42.64	11.19
BUS 96	BUS 95	-26.21	19.20
BUS 96	BUS 97	-5.82	-17.46
Total:		-38.00	-15.00
BUS 97	BUS 80	9.10	-23.48
BUS 97	BUS 96	5.87	15.25
BUS 97	E 2	-29.96	-.77
Total:		-15.00	-9.00
BUS 98	BUS 80	-16.24	-43.44
BUS 98	BUS 100	-47.76	-4.56
Total:		-64.00	-48.00
BUS 101	BUS 100	2.16	.63
BUS 101	BUS 102	-24.16	-15.63
Total:		-22.00	-15.00
BUS 102	BUS 92	-16.09	20.59
BUS 102	BUS 101	24.34	13.34
BUS 102	E 1	-33.25	-36.94
Total:		-25.00	-3.00
BUS 105	BUS 103	-31.15	-14.77
BUS 105	BUS 104	-22.96	-22.86
BUS 105	BUS 106	19.10	14.76
BUS 105	BUS 107	-5.62	3.58
BUS 105	BUS 108	9.63	3.71
BUS 105	BUS 105	.00	-18.42
Total:		-31.00	-34.00
BUS 106	BUS 100	-38.72	-19.63
BUS 106	BUS 105	-19.01	-15.70

BUS 106	BUS 107	-11.27	-.67
Total:		-69.00	-36.00
BUS 108	BUS 105	-9.60	-5.31
BUS 108	BUS 109	7.60	4.31
Total:		-2.00	-1.00
BUS 109	BUS 108	-7.59	-4.97
BUS 109	BUS 110	-40.41	-5.03
Total:		-48.00	-10.00
BUS 110	BUS 103	-14.45	-16.47
BUS 110	BUS 109	40.91	4.56
BUS 110	BUS 111	-35.69	-6.48
BUS 110	BUS 112	-29.77	-1.10
BUS 110	BUS 110	.00	-5.61
Total:		-39.00	-25.10
BUS 113	BUS 17	-.89	-7.00
BUS 113	BUS 32	-5.11	13.40
Total:		-6.00	6.40
BUS 114	BUS 32	-3.77	-9.80
BUS 114	BUS 115	-16.23	6.80
Total:		-20.00	-3.00
BUS 115	BUS 27	-51.24	-2.99
BUS 115	BUS 114	16.24	-7.01
Total:		-35.00	-10.00
BUS 117	BUS 12	-20.00	-8.00
Total:		-20.00	-8.00
BUS 118	BUS 75	-30.42	-21.82
BUS 118	BUS 76	-2.58	6.82
Total:		-33.00	-15.00
A 3	A 1	-45.33	-7.25
A 3	A 4	42.93	6.05
Total:		-2.40	-1.20

A 4	A 2	-34.26	-12.60
A 4	A 3	-42.69	-6.67
A 4	A 6	43.08	.52
A 4	A 12	26.27	17.14
Total:		-7.60	-1.60

A 6	A 2	-43.68	-11.40
A 6	A 4	-42.86	-.22
A 6	A 7	9.19	1.59
A 6	A 8	32.32	1.03
A 6	A 28	21.13	10.80
A 6	A 9	12.66	-3.40
A 6	A 10	11.23	1.60
Total:		.00	.00

A 7	A 5	-13.63	-6.71
A 7	A 6	-9.17	-4.19
Total:		-22.80	-10.90

A 9	A 11	-20.00	-8.53
A 9	A 10	32.66	4.79
A 9	A 6	-12.66	3.74
Total:		.00	.00

A 10	A 9	-32.66	-3.67
A 10	A 20	8.67	3.56
A 10	A 17	4.77	4.50
A 10	A 21	16.53	10.02
A 10	A 22	8.11	4.60
A 10	A 6	-11.23	-.93
A 10	A 10	.00	-20.07
Total:		-5.80	-2.00

A 12	A 13	-20.00	-5.49
A 12	A 14	8.21	2.85
A 12	A 15	19.04	6.83
A 12	A 16	7.82	3.30
A 12	A 4	-26.27	-14.99
Total:		-11.20	-7.50

A 14	A 12	-8.13	-2.67
A 14	A 15	1.93	1.07
Total:		-6.20	-1.60

A 15	A 12	-18.79	-6.34

A 15	A 14	-1.92	-1.06
A 15	A 18	6.37	1.75
A 15	A 23	6.15	3.15
	Total:	-8.20	-2.50
A 16	A 12	-7.75	-3.16
A 16	A 17	4.25	1.36
	Total:	-3.50	-1.80
A 17	A 16	-4.24	-1.33
A 17	A 10	-4.76	-4.47
	Total:	-9.00	-5.80
A 18	A 15	-6.33	-1.66
A 18	A 19	3.13	.76
	Total:	-3.20	-.90
A 19	A 18	-3.12	-.75
A 19	A 20	-6.38	-2.65
	Total:	-9.50	-3.40
A 20	A 19	6.40	2.68
A 20	A 10	-8.60	-3.38
	Total:	-2.20	-.70
A 21	A 10	-16.41	-9.75
A 21	A 22	-1.09	-1.45
	Total:	-17.50	-11.20
A 22	A 10	-8.05	-4.47
A 22	A 21	1.09	1.45
A 22	A 24	6.95	3.02
	Total:	.00	.00
A 23	A 15	-6.10	-3.06
A 23	A 24	2.90	1.46
	Total:	-3.20	-1.60
A 24	A 22	-6.89	-2.92
A 24	A 23	-2.89	-1.43
A 24	A 25	1.08	1.67
A 24	A 24	.00	-4.02

	Total:	-8.70	-6.70
A 25	A 24	-1.07	-1.66
A 25	A 26	3.54	2.37
A 25	A 27	-2.47	-.71
	Total:	.00	.00
A 26	A 25	-3.50	-2.30
	Total:	-3.50	-2.30
A 27	A 25	2.48	.72
A 27	A 29	6.21	2.53
A 27	A 30	7.12	2.89
A 27	A 28	-15.80	-6.14
	Total:	.00	.00
A 28	A 6	-21.04	-11.10
A 28	A 8	.32	-4.05
A 28	BUS 42	4.91	7.87
A 28	A 27	15.80	7.29
	Total:	.00	.00
A 29	A 27	-6.11	-2.34
A 29	A 30	3.71	1.44
	Total:	-2.40	-.90
A 30	A 27	-6.93	-2.54
A 30	A 29	-3.67	-1.36
	Total:	-10.60	-3.90
B 3	B 1	-21.25	-13.71
B 3	B 4	18.85	12.51
	Total:	-2.40	-1.20
B 4	B 2	-20.04	-16.68
B 4	B 3	-18.79	-13.64
B 4	B 6	7.73	2.48
B 4	BUS 21	.47	8.62
B 4	B 12	23.03	17.62
	Total:	-7.60	-1.60
B 6	B 2	-21.56	-16.96

B 6	B 4	-7.72	-2.91
B 6	B 7	30.01	-2.32
B 6	B 8	-12.60	-2.30
B 6	B 28	-13.02	24.54
B 6	B 9	13.29	-2.13
B 6	B 10	11.61	2.08
	Total:	.00	.00

B 7	B 5	6.97	-11.25
B 7	B 6	-29.77	.35
	Total:	-22.80	-10.90

B 9	B 11	-20.00	-7.11
B 9	B 10	33.29	4.63
B 9	B 6	-13.29	2.48
	Total:	.00	.00

B 10	B 9	-33.29	-3.47
B 10	B 20	9.29	3.54
B 10	B 17	6.05	4.42
B 10	B 21	15.99	10.29
B 10	B 22	7.76	4.78
B 10	B 6	-11.61	-1.36
B 10	B 10	.00	-20.19
	Total:	-5.80	-2.00

B 12	B 13	-20.00	-4.90
B 12	B 14	7.78	2.88
B 12	B 15	17.53	6.98
B 12	B 16	6.52	3.33
B 12	B 4	-23.03	-15.79
	Total:	-11.20	-7.50

B 14	B 12	-7.70	-2.72
B 14	B 15	1.50	1.12
	Total:	-6.20	-1.60

B 15	B 12	-17.32	-6.55
B 15	B 14	-1.50	-1.11
B 15	B 18	5.75	1.78
B 15	B 23	4.86	3.39
	Total:	-8.20	-2.50

B 16	B 12	-6.47	-3.23
B 16	B 17	2.97	1.43
	Total:	-3.50	-1.80

B 17	B 16	-2.96	-1.42
B 17	B 10	-6.04	-4.38
	Total:	-9.00	-5.80
B 18	B 15	-5.72	-1.70
B 18	B 19	2.52	.80
	Total:	-3.20	-.90
B 19	B 18	-2.51	-.79
B 19	B 20	-6.99	-2.61
	Total:	-9.50	-3.40
B 20	B 19	7.01	2.65
B 20	B 10	-9.21	-3.35
	Total:	-2.20	-.70
B 21	B 10	-15.88	-10.03
B 21	B 22	-1.62	-1.17
	Total:	-17.50	-11.20
B 22	B 10	-7.70	-4.66
B 22	B 21	1.62	1.17
B 22	B 24	6.07	3.49
	Total:	.00	.00
B 23	B 15	-4.82	-3.32
B 23	B 24	1.62	1.72
	Total:	-3.20	-1.60
B 24	B 22	-6.02	-3.40
B 24	B 23	-1.62	-1.70
B 24	B 25	-1.06	2.45
B 24	B 24	.00	-4.04
	Total:	-8.70	-6.70
B 25	B 24	1.08	-2.43
B 25	B 26	3.54	2.37
B 25	B 27	-4.62	.06
	Total:	.00	.00

B 26	B 25	-3.50	-2.30
	Total:	-3.50	-2.30
B 27	B 25	4.64	-.01
B 27	B 29	6.21	2.52
B 27	B 30	7.11	2.89
B 27	B 28	-17.96	-5.40
	Total:	.00	.00
B 28	B 6	13.15	-24.73
B 28	B 8	1.06	-8.80
B 28	BUS 32	-32.18	26.75
B 28	B 27	17.96	6.78
	Total:	.00	.00
B 29	B 27	-6.11	-2.34
B 29	B 30	3.71	1.44
	Total:	-2.40	-.90
B 30	B 27	-6.93	-2.54
B 30	B 29	-3.67	-1.36
	Total:	-10.60	-3.90
C 3	C 1	-43.55	-7.63
C 3	C 4	41.15	6.43
	Total:	-2.40	-1.20
C 4	C 2	-43.93	-8.51
C 4	C 3	-40.93	-7.11
C 4	C 6	34.96	-10.87
C 4	BUS 95	16.46	8.10
C 4	C 12	25.84	16.79
	Total:	-7.60	-1.60
C 6	C 2	-51.34	-4.85
C 6	C 4	-34.80	10.96
C 6	C 7	5.07	5.73
C 6	C 8	23.90	-10.95
C 6	C 28	32.58	-.90
C 6	C 9	13.09	-2.05
C 6	C 10	11.50	2.07
	Total:	.00	.00

C 7	C 5	-17.75	-2.53
C 7	C 6	-5.05	-8.37
Total:		-22.80	-10.90

C 9	C 11	-20.00	-6.85
C 9	C 10	33.09	4.46
C 9	C 6	-13.09	2.39
Total:		.00	.00

C 10	C 9	-33.09	-3.31
C 10	C 20	8.83	3.78
C 10	C 17	5.01	4.96
C 10	C 21	16.72	9.75
C 10	C 22	8.23	4.42
C 10	C 6	-11.50	-1.37
C 10	C 10	.00	-20.22
Total:		-5.80	-2.00

C 12	C 13	-20.00	-4.56
C 12	C 14	8.17	2.68
C 12	C 15	18.89	6.26
C 12	C 16	7.58	2.82
C 12	C 4	-25.84	-14.71
Total:		-11.20	-7.50

C 14	C 12	-8.09	-2.51
C 14	C 15	1.89	.91
Total:		-6.20	-1.60

C 15	C 12	-18.65	-5.79
C 15	C 14	-1.88	-.90
C 15	C 18	6.21	1.54
C 15	C 23	6.12	2.65
Total:		-8.20	-2.50

C 16	C 12	-7.52	-2.70
C 16	C 17	4.02	.90
Total:		-3.50	-1.80

C 17	C 16	-4.01	-.87
C 17	C 10	-4.99	-4.93
Total:		-9.00	-5.80

C 18	C 15	-6.17	-1.45

C 18	C 19	2.97	.55
	Total:	-3.20	-.90
C 19	C 18	-2.97	-.54
C 19	C 20	-6.53	-2.86
	Total:	-9.50	-3.40
C 20	C 19	6.55	2.89
C 20	C 10	-8.75	-3.59
	Total:	-2.20	-.70
C 21	C 10	-16.60	-9.49
C 21	C 22	-.90	-1.71
	Total:	-17.50	-11.20
C 22	C 10	-8.17	-4.30
C 22	C 21	.90	1.71
C 22	C 24	7.26	2.58
	Total:	.00	.00
C 23	C 15	-6.07	-2.57
C 23	C 24	2.87	.97
	Total:	-3.20	-1.60
C 24	C 22	-7.20	-2.48
C 24	C 23	-2.86	-.94
C 24	C 25	1.36	.77
C 24	C 24	.00	-4.05
	Total:	-8.70	-6.70
C 25	C 24	-1.36	-.77
C 25	C 26	3.54	2.37
C 25	C 27	-2.18	-1.60
	Total:	.00	.00
C 26	C 25	-3.50	-2.30
	Total:	-3.50	-2.30
C 27	C 25	2.19	1.62
C 27	C 29	6.21	2.52
C 27	C 30	7.11	2.89
C 27	C 28	-15.51	-7.03

	Total:	.00	.00
C 28	C 6	-32.40	.87
C 28	C 8	-4.76	-2.87
C 28	BUS 82	21.65	-6.16
C 28	C 27	15.51	8.16
	Total:	.00	.00
C 29	C 27	-6.11	-2.34
C 29	C 30	3.71	1.44
	Total:	-2.40	-.90
C 30	C 27	-6.93	-2.54
C 30	C 29	-3.67	-1.36
	Total:	-10.60	-3.90
D 3	D 1	-9.58	-8.31
D 3	D 4	7.18	7.11
	Total:	-2.40	-1.20
D 4	D 2	-21.55	-7.27
D 4	D 3	-7.17	-8.36
D 4	D 6	-16.06	-3.86
D 4	BUS 51	15.36	3.51
D 4	D 12	21.82	14.38
	Total:	-7.60	-1.60
D 6	D 2	-17.51	-6.67
D 6	D 4	16.09	3.52
D 6	D 7	-8.09	7.98
D 6	D 8	-25.03	-10.05
D 6	D 28	7.75	6.79
D 6	D 9	14.50	-3.24
D 6	D 10	12.29	1.68
	Total:	.00	.00
D 7	D 5	-30.93	-.37
D 7	D 6	8.13	-10.53
	Total:	-22.80	-10.90
D 9	D 11	-20.00	-8.36
D 9	D 10	34.50	4.69
D 9	D 6	-14.50	3.67
	Total:	.00	.00

D 10	D 9	-34.50	-3.44
D 10	D 20	9.71	3.50
D 10	D 17	6.74	4.39
D 10	D 21	16.48	9.96
D 10	D 22	8.07	4.56
D 10	D 6	-12.29	-.88
D 10	D 10	.00	-20.09
	Total:	-5.80	-2.00

D 12	D 13	-20.00	-7.69
D 12	D 14	7.66	2.84
D 12	D 15	17.13	6.86
D 12	D 16	5.83	3.35
D 12	D 4	-21.82	-12.86
	Total:	-11.20	-7.50

D 14	D 12	-7.58	-2.68
D 14	D 15	1.38	1.08
	Total:	-6.20	-1.60

D 15	D 12	-16.92	-6.45
D 15	D 14	-1.38	-1.08
D 15	D 18	5.34	1.83
D 15	D 23	4.76	3.20
	Total:	-8.20	-2.50

D 16	D 12	-5.79	-3.27
D 16	D 17	2.29	1.47
	Total:	-3.50	-1.80

D 17	D 16	-2.28	-1.45
D 17	D 10	-6.72	-4.35
	Total:	-9.00	-5.80

D 18	D 15	-5.31	-1.76
D 18	D 19	2.11	.86
	Total:	-3.20	-.90

D 19	D 18	-2.11	-.85
D 19	D 20	-7.39	-2.55
	Total:	-9.50	-3.40

D 20	D 19	7.41	2.59
D 20	D 10	-9.61	-3.29
Total:		-2.20	-.70
D 21	D 10	-16.35	-9.70
D 21	D 22	-1.15	-1.50
Total:		-17.50	-11.20
D 22	D 10	-8.01	-4.44
D 22	D 21	1.15	1.50
D 22	D 24	6.86	2.93
Total:		.00	.00
D 23	D 15	-4.73	-3.14
D 23	D 24	1.53	1.54
Total:		-3.20	-1.60
D 24	D 22	-6.80	-2.84
D 24	D 23	-1.52	-1.52
D 24	D 25	-.38	1.69
D 24	D 24	.00	-4.02
Total:		-8.70	-6.70
D 25	D 24	.38	-1.68
D 25	D 26	3.54	2.37
D 25	D 27	-3.92	-.69
Total:		.00	.00
D 26	D 25	-3.50	-2.30
Total:		-3.50	-2.30
D 27	D 25	3.94	.73
D 27	D 29	6.21	2.52
D 27	D 30	7.11	2.89
D 27	D 28	-17.26	-6.14
Total:		.00	.00
D 28	D 6	-7.73	-7.37
D 28	D 8	-7.61	-4.94
D 28	BUS 59	-1.92	4.86
D 28	D 27	17.26	7.46
Total:		.00	.00

D 29	D 27	-6.11	-2.34
D 29	D 30	3.71	1.44
Total:		-2.40	-.90
D 30	D 27	-6.93	-2.54
D 30	D 29	-3.67	-1.36
Total:		-10.60	-3.90
E 4	E 2	-39.97	-13.16
E 4	E 3	31.15	-6.00
E 4	E 5	-81.51	7.92
E 4	E 7	27.04	-8.54
E 4	E 9	15.49	-.23
Total:		-47.80	-20.00
E 5	E 1	-51.74	-18.47
E 5	E 2	-20.52	-16.39
E 5	E 4	82.44	-6.23
E 5	BUS 90	-63.57	27.67
E 5	E 6	45.80	11.82
Total:		-7.60	-1.60
E 7	E 8	.00	-15.43
E 7	E 9	27.04	5.23
E 7	E 4	-27.04	10.20
Total:		.00	.00
E 9	E 7	-27.04	-4.43
E 9	E 10	4.27	3.10
E 9	E 14	8.76	2.91
E 9	E 4	-15.49	1.53
E 9	E 9	.00	-19.70
Total:		-29.50	-16.60
E 10	E 9	-4.26	-3.07
E 10	E 11	-4.74	-2.73
Total:		-9.00	-5.80
E 11	E 6	-8.26	-4.58
E 11	E 10	4.76	2.78
Total:		-3.50	-1.80

E 12	E 6	-7.88	-2.48
E 12	E 13	1.78	.88
Total:		-6.10	-1.60

E 13	E 6	-18.05	-7.39
E 13	E 12	-1.77	-.88
E 13	E 14	6.32	2.47
Total:		-13.50	-5.80

E 14	E 9	-8.65	-2.69
E 14	E 13	-6.25	-2.31
Total:		-14.90	-5.00

System losses:	153.79	-584.89
R*I**2,X*I**2:	153.79	872.16

Appendix H

250 Bus Network

$$P_D = 1.25 \cdot P_{Dlow}$$

$$Q_D = 1.40 \cdot Q_{Dlow}$$

H.1 Bus Oriented Results

H.2 Line Flow Results

Time for input: 3.05
Time for compact: .27
Time for factorization: .32
o. of iterations: 34
aximum mismatch (in pu): 9.0E-05 9.7E-04
Time for solution: .95
xecution time: 4.60

base : 100.

Bus	Vsp	Voltage		Generation		QGmin	QGmax	Load	
US 69		1.035	30.00	348.95	-47.85				
US 1	.960	.950-	4.76	.00	35.00	-5.00	35.00	63.75	37.80
US 4	.998	.998	11.91	50.00	33.16	-300.00	300.00	37.50	16.80
US 6	.990	.983-	8.00	.00	50.00	-13.00	50.00	65.00	30.80
US 8	1.015	1.015	19.51	40.00	224.83	-300.00	300.00	.00	14.00
US 10	1.055	1.055	38.53	570.00	60.69	-147.00	200.00	.00	.00
US 12	.990	.978-	7.01	85.00	120.00	-35.00	120.00	58.75	28.00
US 15	.970	.970	5.99	.00	47.02	-10.00	50.00	112.50	56.00
JS 18	.973	.973	6.25	.00	37.93	-16.00	50.00	75.00	47.60
JS 19	.960	.968+	5.31	.00	-8.00	-8.00	24.00	56.25	35.00
JS 24	.992	.992	19.48	49.00	13.35	-300.00	300.00	.00	.00
JS 25	1.050	1.050	25.93	220.00	86.72	-47.00	140.00	.00	.00
JS 26	1.015	1.015	29.12	420.00	23.32	-1000.00	1000.00	.00	.00
JS 27	.968	.968	11.89	45.00	12.54	-300.00	300.00	25.00	18.20
JS 31	.967	.967	7.36	7.00	63.98	-300.00	300.00	53.75	37.80
JS 32	.963	.963	9.05	.00	27.50	-14.00	42.00	73.75	32.20
JS 34	.984	.984	8.50	.00	15.54	-8.00	24.00	73.75	36.40
JS 36	.980	.978-	8.00	.00	24.00	-8.00	24.00	38.75	23.80
JS 40	.970	.970	7.48	.00	-6.64	-300.00	300.00	25.00	32.20
JS 42	.985	.985	9.26	.00	37.96	-300.00	300.00	46.25	32.20
JS 46	1.080	1.066-	17.03	89.00	100.00	-100.00	100.00	35.00	14.00
JS 49	1.025	1.025	20.58	300.00	55.58	-85.00	210.00	108.75	42.00
IS 54	.970	.970	15.11	48.00	40.23	-300.00	300.00	141.25	72.80
IS 55	.970	.969-	14.82	.00	23.00	-8.00	23.00	78.75	30.80
IS 56	.970	.972+	15.24	.00	-8.00	-8.00	15.00	105.00	53.20
IS 59	.985	.985	18.02	155.00	109.94	-60.00	180.00	346.25	158.20
IS 61	.995	.995	22.91	160.00	14.28	-100.00	300.00	.00	.00
IS 62	.998	.996-	21.74	.00	30.00	-20.00	30.00	96.25	33.60
IS 65	1.005	1.005	28.96	500.00	143.69	-67.00	200.00	.00	.00
IS 66	1.050	1.050	26.98	500.00	28.22	-67.00	200.00	48.75	25.20
S 70	.984	.984	23.06	.00	24.60	-10.00	32.00	82.50	28.00
S 72	.980	.980	24.43	43.00	-23.24	-100.00	100.00	.00	.00
S 73	.991	.991	24.89	37.00	.94	-100.00	100.00	.00	.00
S 74	.975	.962-	20.78	.00	39.00	-6.00	39.00	85.00	37.80
S 76	.953	.951-	21.63	.00	53.00	-8.00	53.00	85.00	51.80
S 77	1.006	1.006	29.83	.00	58.88	-20.00	70.00	76.25	28.00
S 80	1.040	1.040	33.81	600.00	218.20	-165.00	280.00	162.50	78.40
S 85	1.020	1.018-	36.77	.00	23.00	-8.00	23.00	30.00	21.00
S 87	1.015	1.015	35.63	4.00	-19.33	-100.00	1000.00	.00	.00
S 89	1.055	1.055	46.39	750.00	118.95	-210.00	300.00	.00	.00
S 90	.985	.985	40.31	.00	3.54	-300.00	300.00	97.50	72.80
S 91	.985	.985	41.74	20.00	-43.17	-100.00	100.00	.00	.00
S 92	1.030	1.030	41.50	.00	15.33	-3.00	20.00	81.25	28.00
S 99	1.015	1.015	38.41	35.00	-24.54	-100.00	100.00	.00	.00
S 100	1.017	1.017	38.47	350.00	94.40	-50.00	155.00	46.25	25.20

BUS 103	1.000	.998-	35.58	40.00	50.00	-15.00	50.00	28.75	22.40
BUS 104	.971	.969-	32.53	.00	53.00	-8.00	53.00	47.50	35.00
BUS 107	.952	.952	32.04	45.00	14.32	-200.00	200.00	35.00	16.80
BUS 111	.980	.980	33.90	36.00	13.41	-100.00	1000.00	.00	.00
BUS 112	.975	.975	33.19	55.00	29.13	-100.00	1000.00	31.25	18.20
BUS 116	1.005	1.005	30.04	.00	88.43	-1000.00	1000.00	.00	.00
A 1	1.050	1.050	14.47	100.00	36.68	-100.00	100.00	.00	.00
A 2	1.045	1.033-	11.92	80.00	80.00	-20.00	80.00	27.13	17.78
A 5	1.010	.994-	7.35	50.00	62.45	-15.00	62.45	117.75	54.60
A 8	1.000	.988-	7.44	20.00	85.00	-15.00	85.00	37.50	42.00
A 11	1.050	1.050	7.91	20.00	17.24	-10.00	45.83	.00	.00
A 13	1.050	1.050	5.53	20.00	17.79	-15.00	56.57	.00	.00
B 1	1.050	1.049-	3.35	100.00	100.00	-100.00	100.00	.00	.00
B 2	1.045	1.039-	2.16	80.00	60.00	-20.00	60.00	27.13	17.78
B 5	1.010	.997-	-3.30	50.00	62.45	-15.00	62.45	117.75	54.60
B 8	1.010	.989-	1.41	20.00	75.00	-15.00	75.00	37.50	42.00
B 11	1.050	1.050	.65	20.00	17.66	-10.00	45.83	.00	.00
B 13	1.050	1.050	-2.06	20.00	18.84	-15.00	56.57	.00	.00
C 1	1.050	1.050	41.36	100.00	34.65	-100.00	100.00	.00	.00
C 2	1.045	1.045-	40.05	80.00	60.00	-20.00	60.00	27.13	17.78
C 5	1.010	1.010	35.53	50.00	50.75	-15.00	62.45	117.75	54.60
C 8	1.010	1.004-	33.41	20.00	75.00	-15.00	75.00	37.50	42.00
C 11	1.050	1.050	34.10	20.00	14.89	-10.00	45.83	.00	.00
C 13	1.050	1.050	31.90	20.00	16.03	-15.00	56.57	.00	.00
D 1	1.025	1.019-	17.76	100.00	100.00	-100.00	100.00	.00	.00
D 2	1.020	1.020	19.00	80.00	28.64	-20.00	60.00	27.13	17.78
D 5	1.010	1.010	21.86	50.00	33.48	-15.00	62.45	117.75	54.60
D 8	1.010	1.006-	18.42	20.00	75.00	-15.00	75.00	37.50	42.00
D 11	1.050	1.050	17.25	20.00	15.61	-10.00	45.83	.00	.00
D 13	1.050	1.050	14.26	20.00	18.28	-15.00	56.57	.00	.00
E 1	1.060	1.055-	41.51	300.00	90.00	-40.00	90.00	25.00	16.80
E 2	1.045	1.017-	36.22	40.00	50.00	-40.00	50.00	27.13	17.78
E 3	.970	.969-	27.23	.00	70.00	.00	70.00	117.75	54.60
E 6	1.040	1.037-	27.24	.00	34.00	-6.00	34.00	14.00	10.50
E 8	1.050	1.050	28.24	.00	23.98	-6.00	34.00	.00	.00

Bus	Voltage		Load	
US 2	.960	5.66	25.00	12.60
US 3	.955	6.08	62.50	28.00
US 5	.999	12.31	50.00	25.20
US 7	.977	7.17	63.75	19.60
US 9	1.028	28.91	.00	.00
US 11	.974	8.01	87.50	32.20
US 13	.954	6.27	42.50	22.40
US 14	.971	6.23	17.50	7.00
US 16	.972	6.79	31.25	14.00
US 17	.994	9.38	13.75	4.20
US 20	1.010	3.02	22.50	9.80
US 21	.984	1.61	55.00	21.00
US 22	.971	3.66	56.25	18.20
US 23	.980	16.55	77.50	39.20
JS 28	.957	9.27	21.25	9.80
JS 29	.958	7.50	30.00	19.60
JS 30	.980	16.43	.00	.00
JS 33	.966	6.50	28.75	12.60
JS 35	.977	8.04	41.25	26.60
JS 37	.989	9.28	.00	.00
JS 38	.956	15.14	.00	.00
JS 39	.967	7.45	33.75	15.40
JS 41	.964	7.03	46.25	14.00
JS 43	.977	7.25	22.50	9.80
JS 44	.994	8.51	20.00	11.20
JS 45	1.000	11.87	103.75	63.00
JS 47	1.014	19.38	80.00	42.00
JS 48	1.033	18.30	25.00	15.40
JS 50	1.003	18.48	21.25	5.60
JS 51	.976	16.12	21.25	11.20
JS 52	.964	15.01	22.50	7.00
JS 53	.953	13.94	28.75	15.40
JS 57	.981	16.14	15.00	4.20
JS 58	.971	15.39	15.00	4.20
JS 60	.986	21.86	97.50	60.20
JS 63	.967	22.11	.00	.00
JS 64	.982	24.26	.00	.00
JS 67	1.012	21.46	35.00	9.80
JS 68	1.001	30.05	.00	.00
JS 71	.987	23.91	.00	.00
JS 75	.960	22.31	100.00	35.00
JS 78	1.000	29.61	88.75	36.40
JS 79	1.004	30.28	48.75	44.80
JS 81	.993	31.50	.00	.00
S 82	.992	32.43	67.50	37.80
S 83	.999	33.36	25.00	14.00
S 84	1.005	35.41	13.75	9.80
S 86	1.016	35.15	26.25	14.00
S 88	1.018	41.30	60.00	35.00
S 93	1.007	38.70	15.00	9.80
S 94	.998	36.74	37.50	22.40
S 95	.986	35.06	52.50	43.40
S 96	.994	33.97	47.50	21.00
S 97	1.012	34.46	18.75	12.60
S 98	.973	33.00	80.00	67.20
S 101	1.013	38.93	27.50	21.00

US 102	1.037	40.77	31.25	4.20
US 105	.951	31.86	38.75	47.60
US 106	.934	31.29	86.25	50.40
US 108	.943	30.95	2.50	1.40
US 109	.940	30.62	60.00	14.00
US 110	.961	32.44	48.75	35.14
US 113	.992	9.17	7.50	-8.96
US 114	.954	8.92	25.00	4.20
US 115	.953	9.05	43.75	14.00
US 117	.955	5.06	25.00	11.20
US 118	.947	21.42	41.25	21.00
3	1.005	9.76	3.00	1.68
4	.995	8.83	9.50	2.24
6	.990	7.99	.00	.00
7	.980	7.00	28.50	15.26
9	1.017	5.68	.00	.00
10	1.003	3.21	7.25	2.80
12	1.027	4.05	14.00	10.50
14	1.004	2.93	7.75	2.24
15	.998	2.79	10.25	3.50
16	1.007	3.37	4.38	2.52
17	.997	3.04	11.25	8.12
18	.983	2.01	4.00	1.26
19	.979	1.81	11.88	4.76
20	.984	2.08	2.75	.98
21	.986	2.63	21.88	15.68
22	.986	2.64	.00	.00
23	.981	2.32	4.00	2.24
24	.969	2.13	10.88	9.38
25	.964	2.49	.00	.00
26	.941	1.86	4.38	3.22
27	.973	3.04	.00	.00
28	.983	8.11	.00	.00
29	.940	1.51	3.00	1.26
30	.919	.43	13.25	5.46
3	1.003	1.27	3.00	1.68
4	.993	.93	9.50	2.24
6	.989	.79	.00	.00
7	.980	-1.49	28.50	15.26
9	1.016	-1.59	.00	.00
10	1.002	-4.09	7.25	2.80
12	1.025	-3.55	14.00	10.50
14	1.003	-4.62	7.75	2.24
15	.997	-4.71	10.25	3.50
16	1.006	-4.09	4.38	2.52
17	.996	-4.31	11.25	8.12
18	.982	-5.42	4.00	1.26
19	.977	-5.58	11.88	4.76
20	.983	-5.29	2.75	.98
21	.984	-4.65	21.88	15.68
22	.985	-4.63	.00	.00
23	.979	-5.04	4.00	2.24
24	.967	-5.02	10.88	9.38
25	.961	-4.22	.00	.00
26	.939	-4.85	4.38	3.22
27	.970	-3.38	.00	.00
28	.976	2.11	.00	.00
29	.937	-4.93	3.00	1.26
30	.915	-6.01	13.25	5.46
3	1.007	36.32	3.00	1.68

C 4	.997	35.32	9.50	2.24
C 6	.998	34.19	.00	.00
C 7	.992	33.96	28.50	15.26
C 9	1.021	31.88	.00	.00
C 10	1.008	29.41	7.25	2.80
C 12	1.029	30.42	14.00	10.50
C 14	1.007	29.26	7.75	2.24
C 15	1.001	29.09	10.25	3.50
C 16	1.011	29.67	4.38	2.52
C 17	1.002	29.27	11.25	8.12
C 18	.987	28.29	4.00	1.26
C 19	.983	28.06	11.88	4.76
C 20	.988	28.33	2.75	.98
C 21	.991	28.81	21.88	15.68
C 22	.991	28.81	.00	.00
C 23	.984	28.51	4.00	2.24
C 24	.974	28.18	10.88	9.38
C 25	.969	28.09	.00	.00
C 26	.947	27.47	4.38	3.22
C 27	.979	28.37	.00	.00
C 28	.992	32.99	.00	.00
C 29	.947	26.85	3.00	1.26
30	.925	25.79	13.25	5.46
3	.996	17.07	3.00	1.68
4	.992	17.01	9.50	2.24
6	.996	17.57	.00	.00
7	.989	18.45	28.50	15.26
9	1.020	15.02	.00	.00
10	1.007	12.43	7.25	2.80
12	1.026	12.77	14.00	10.50
14	1.004	11.71	7.75	2.24
15	.999	11.63	10.25	3.50
16	1.008	12.31	4.38	2.52
17	1.001	12.18	11.25	8.12
18	.985	10.99	4.00	1.26
19	.981	10.86	11.88	4.76
20	.986	11.18	2.75	.98
21	.989	11.83	21.88	15.68
22	.990	11.84	.00	.00
23	.982	11.28	4.00	2.24
24	.972	11.26	10.88	9.38
25	.969	11.68	.00	.00
26	.947	11.06	4.38	3.22
27	.979	12.28	.00	.00
28	.990	17.38	.00	.00
29	.947	10.76	3.00	1.26
30	.925	9.70	13.25	5.46
4	.967	32.20	59.75	28.00
5	.979	35.08	9.50	2.24
7	1.010	28.24	.00	.00
9	.997	26.17	36.88	23.24
10	.994	25.99	11.25	8.12
11	1.010	26.46	4.38	2.52
12	1.016	26.09	7.63	2.24
13	1.007	26.01	16.88	8.12
14	.977	24.74	18.63	7.00

'ower Generated:	7101.95	3599.27
'ower Demanded:	6852.00	3611.86
ystem Losses:	249.95	-12.59

rintout time: 1.30

BUS 69	BUS 47	67.71	-10.01
BUS 69	BUS 49	51.19	-12.38
BUS 69	BUS 70	102.36	21.41
BUS 69	BUS 75	119.35	28.97
BUS 69	BUS 77	11.14	24.62
BUS 69	BUS 68	-2.80	-100.45
Total:		348.95	-47.85

BUS 1	BUS 2	-15.69	-6.02
BUS 1	BUS 3	-48.06	3.21
Total:		-63.75	-2.81

BUS 4	BUS 5	-85.80	9.25
BUS 4	BUS 11	98.30	7.11
Total:		12.51	16.36

BUS 6	BUS 5	-135.22	5.56
BUS 6	BUS 7	70.22	13.62
Total:		-65.00	19.18

BUS 8	BUS 9	-554.94	21.11
BUS 8	BUS 30	111.50	37.08
BUS 8	BUS 5	483.44	152.65
Total:		40.00	210.83

BUS 10	BUS 9	570.00	60.69
Total:		570.00	60.69

BUS 12	BUS 11	-72.01	44.01
BUS 12	BUS 2	41.17	16.38
BUS 12	BUS 3	12.66	8.68
BUS 12	BUS 7	-6.22	5.70
BUS 12	BUS 14	19.57	3.24
BUS 12	BUS 16	5.82	5.04
BUS 12	BUS 117	25.26	8.95
Total:		26.25	92.00

BUS 15	BUS 13	.06	3.31
BUS 15	BUS 14	-1.98	-2.41
BUS 15	BUS 17	-133.06	-9.48
BUS 15	BUS 19	27.73	-3.46
BUS 15	BUS 33	-5.25	3.06
Total:		-112.50	-8.98

BUS 18	BUS 17	-107.24	-11.77
BUS 18	BUS 19	32.24	2.10
Total:		-75.00	-9.67

BUS 19	BUS 18	-32.11	-2.63
BUS 19	BUS 20	24.78	-41.01
BUS 19	BUS 15	-27.63	2.84
BUS 19	BUS 34	-21.29	-2.21
Total:		-56.25	-43.00

BUS 24	BUS 23	100.82	-2.44
BUS 24	BUS 70	-13.38	.70
BUS 24	BUS 72	-38.44	15.09
Total:		49.00	13.35

BUS 25	BUS 23	222.54	64.07
BUS 25	BUS 27	159.17	38.19
BUS 25	BUS 26	-161.70	-15.54
Total:		220.01	86.71

BUS 26	BUS 30	258.31	-1.36
BUS 26	BUS 25	161.70	24.68
Total:		420.01	23.32

BUS 27	BUS 25	-151.39	-2.41
BUS 27	BUS 28	50.04	1.56
BUS 27	BUS 32	58.21	-10.63
BUS 27	BUS 115	63.13	5.82
Total:		20.00	-5.66

BUS 31	BUS 17	-24.39	-10.68
BUS 31	BUS 29	2.03	26.32
BUS 31	BUS 32	-24.38	10.54
Total:		-46.75	26.18

BUS 32	BUS 23	-101.24	18.70
BUS 32	BUS 31	24.62	-12.11
BUS 32	BUS 27	-57.36	11.64
BUS 32	BUS 113	-4.77	-14.89
BUS 32	BUS 114	6.36	12.19
BUS 32	B 28	58.64	-20.23
Total:		-73.75	-4.70

BUS 34	BUS 19	21.65	-2.62
BUS 34	BUS 36	35.13	11.15
BUS 34	BUS 37	-143.31	-14.79
BUS 34	BUS 43	12.79	-1.04
BUS 34	BUS 34	.00	-13.56
Total:		-73.75	-20.86

BUS 36	BUS 35	-3.75	11.52
BUS 36	BUS 34	-35.00	-11.32
Total:		-38.75	.20

BUS 40	BUS 37	-19.27	-5.99
BUS 40	BUS 39	2.02	2.84
BUS 40	BUS 41	17.34	5.93
BUS 40	BUS 42	-16.94	-4.76
BUS 40	A 8	-8.15	-36.86
Total:		-25.00	-38.84

BUS 42	BUS 40	17.11	.87
BUS 42	BUS 41	29.35	5.10
BUS 42	BUS 49	-59.77	2.94
BUS 42	BUS 49	-59.77	2.94
BUS 42	A 28	26.84	-6.10
Total:		-46.25	5.76

BUS 46	BUS 45	80.15	30.17
BUS 46	BUS 47	-19.78	49.04
BUS 46	BUS 48	-6.37	18.16
BUS 46	BUS 46	.00	-11.37
Total:		54.00	86.00

BUS 49	BUS 47	36.97	6.59
BUS 49	BUS 42	62.44	.43
BUS 49	BUS 42	62.44	.43
BUS 49	BUS 45	80.07	-11.46
BUS 49	BUS 48	69.13	-40.45
BUS 49	BUS 50	54.11	10.22
BUS 49	BUS 51	62.60	14.50
BUS 49	BUS 54	35.81	8.15
BUS 49	BUS 54	35.62	6.45
BUS 49	BUS 66	-129.62	3.50
BUS 49	BUS 66	-129.62	3.50
BUS 49	BUS 69	-48.72	11.72
Total:		191.25	13.58

BUS 54	BUS 53	17.56	8.67
BUS 54	BUS 49	-34.82	-11.57
BUS 54	BUS 49	-34.48	-9.92

BUS 54	BUS 55	6.65	-1.43
BUS 54	BUS 56	-26.75	-14.40
BUS 54	BUS 59	-21.40	-3.93
Total:		-93.25	-32.57

BUS 55	BUS 54	-6.64	-.44
BUS 55	BUS 56	-47.20	-3.77
BUS 55	BUS 59	-24.91	-3.59
Total:		-78.75	-7.80

BUS 56	BUS 54	26.78	14.22
BUS 56	BUS 55	47.32	3.78
BUS 56	BUS 57	-16.48	-4.03
BUS 56	BUS 58	-2.00	.34
BUS 56	BUS 59	-18.03	-1.28
BUS 56	BUS 59	-18.89	-.94
BUS 56	D 1	-123.70	-73.28
Total:		-105.00	-61.20

BUS 59	BUS 54	21.64	-.67
BUS 59	BUS 56	18.32	-3.30
BUS 59	BUS 56	19.19	-3.29
BUS 59	BUS 55	25.22	-.38
BUS 59	BUS 60	-42.65	8.08
BUS 59	BUS 61	-54.03	5.75
BUS 59	D 28	4.21	-4.89
BUS 59	BUS 63	-183.15	-49.56
Total:		-191.25	-48.26

BUS 61	BUS 59	55.04	-4.94
BUS 61	BUS 60	141.25	37.13
BUS 61	BUS 62	51.07	-12.50
BUS 61	BUS 64	-87.36	-5.41
Total:		160.00	14.28

BUS 62	BUS 60	.13	15.50
BUS 62	BUS 61	-50.84	12.57
BUS 62	BUS 66	-46.53	-15.55
BUS 62	BUS 67	.99	-16.12
Total:		-96.25	-3.60

BUS 65	BUS 38	238.00	3.79
BUS 65	BUS 64	273.28	44.70
BUS 65	BUS 68	-116.87	21.13
BUS 65	BUS 66	105.59	74.07
Total:		500.01	143.69

BUS 66	BUS 49	132.50	8.54
BUS 66	BUS 49	132.50	8.54
BUS 66	BUS 62	47.66	14.41
BUS 66	BUS 67	105.18	19.04
BUS 66	D 5	139.00	21.22
BUS 66	BUS 65	-105.59	-68.74
Total:		451.25	3.02

BUS 70	BUS 69	-99.28	-11.86
BUS 70	BUS 24	13.60	-9.77
BUS 70	BUS 71	-40.39	1.00
BUS 70	BUS 74	30.88	6.17
BUS 70	BUS 75	12.68	11.04
Total:		-82.50	-3.40

BUS 72	BUS 24	39.32	-16.28
BUS 72	BUS 71	3.68	-6.95
Total:		43.00	-23.24

BUS 73	BUS 71	37.00	.94
Total:		37.00	.94

BUS 74	BUS 70	-30.46	-7.98
BUS 74	BUS 75	-54.54	20.27
BUS 74	BUS 74	.00	-11.10
Total:		-85.00	1.20

BUS 76	BUS 77	-92.43	-2.69
BUS 76	BUS 118	7.43	3.89
Total:		-85.00	1.20

BUS 77	BUS 76	96.63	13.15
BUS 77	BUS 69	-10.90	-27.15
BUS 77	BUS 75	65.49	4.96
BUS 77	BUS 78	40.38	32.88
BUS 77	BUS 80	-153.79	-12.25
BUS 77	BUS 80	-71.99	-11.17
BUS 77	BUS 82	-42.06	30.46
Total:		-76.25	30.88

BUS 80	BUS 77	157.79	21.91
BUS 80	BUS 77	73.53	14.26
BUS 80	BUS 79	98.93	33.21
BUS 80	BUS 96	3.42	22.70
BUS 80	BUS 97	-6.34	31.06

BUS 80	BUS 98	26.15	57.04
BUS 80	BUS 99	-36.17	19.29
BUS 80	BUS 81	120.20	-59.67
Total:		437.50	139.80
BUS 85	BUS 83	41.41	.35
BUS 85	BUS 84	39.55	3.76
BUS 85	BUS 86	22.43	-5.87
BUS 85	BUS 88	-76.59	16.69
BUS 85	BUS 89	-103.53	-14.58
BUS 85	C 5	46.73	1.66
Total:		-30.00	2.00
BUS 87	BUS 86	4.00	-19.33
Total:		4.00	-19.33
BUS 89	BUS 85	106.01	.14
BUS 89	BUS 88	140.39	32.82
BUS 89	BUS 90	65.26	21.47
BUS 89	BUS 90	122.47	49.18
BUS 89	BUS 92	187.74	22.54
BUS 89	BUS 92	59.60	2.06
BUS 89	C 2	68.53	-9.27
Total:		750.00	118.95
BUS 90	BUS 89	-63.00	-18.77
BUS 90	BUS 89	-118.72	-36.28
BUS 90	BUS 91	-26.47	7.37
BUS 90	E 5	110.69	-21.57
Total:		-97.50	-69.26
BUS 91	BUS 90	26.67	-8.78
BUS 91	BUS 92	-6.67	-34.40
Total:		20.00	-43.17
BUS 92	BUS 89	-184.56	-7.66
BUS 92	BUS 89	-58.34	-1.49
BUS 92	BUS 91	7.12	32.55
BUS 92	BUS 93	62.81	8.95
BUS 92	BUS 94	55.89	3.94
BUS 92	BUS 100	18.95	-3.22
BUS 92	BUS 102	20.88	-17.63
BUS 92	C 1	-4.00	-28.11
Total:		-81.25	-12.67
BUS 99	BUS 80	36.93	-21.62

BUS 99	BUS 100	-1.93	-2.92
Total:		35.00	-24.54
BUS 100	BUS 92	-18.73	-3.86
BUS 100	BUS 94	57.99	15.38
BUS 100	BUS 98	56.05	12.47
BUS 100	BUS 99	1.93	1.22
BUS 100	BUS 101	-5.53	2.61
BUS 100	BUS 103	100.41	8.16
BUS 100	BUS 104	53.24	11.75
BUS 100	BUS 106	58.40	21.46
Total:		303.75	69.20
BUS 103	BUS 100	-98.84	-4.67
BUS 103	BUS 104	34.94	6.52
BUS 103	BUS 105	43.14	14.01
BUS 103	BUS 110	32.01	11.73
Total:		11.25	27.60
BUS 104	BUS 100	-51.91	-11.18
BUS 104	BUS 103	-34.33	-8.40
BUS 104	BUS 105	38.74	37.58
Total:		-47.50	18.00
BUS 107	BUS 105	1.63	-1.86
BUS 107	BUS 106	8.37	4.82
BUS 107	BUS 107	.00	-5.44
Total:		10.00	-2.48
BUS 111	BUS 110	36.00	13.41
Total:		36.00	13.41
BUS 112	BUS 110	23.75	10.93
Total:		23.75	10.93
BUS 116	BUS 68	.00	88.43
Total:		.00	88.43
A 1	A 2	85.27	3.20
A 1	A 3	50.46	14.10
A 1	BUS 48	-35.72	19.38
Total:		100.00	36.68

A 2	A 1	-84.00	-2.26
A 2	A 4	35.73	8.70
A 2	A 5	43.91	10.09
A 2	A 6	43.81	9.05
A 2	BUS 45	13.43	36.64
	Total:	52.88	62.22

A 5	A 2	-43.00	-8.42
A 5	A 7	6.94	5.58
A 5	BUS 44	-31.68	10.70
	Total:	-67.75	7.85

A 8	A 6	-21.46	2.84
A 8	A 28	-4.37	3.07
A 8	BUS 40	8.33	37.09
	Total:	-17.50	43.00

A 11	A 9	20.00	17.24
	Total:	20.00	17.24

A 13	A 12	20.00	17.79
	Total:	20.00	17.79

B 1	B 2	41.13	4.22
B 1	B 3	25.57	19.25
B 1	BUS 20	33.30	76.53
	Total:	100.00	100.00

B 2	B 1	-40.83	-6.20
B 2	B 4	19.69	18.01
B 2	B 5	52.57	10.88
B 2	B 6	21.44	19.53
	Total:	52.87	42.22

B 5	B 2	-51.30	-7.71
B 5	B 7	-16.45	15.56
	Total:	-67.75	7.85

B 8	B 6	23.72	-6.29
B 8	B 28	-3.56	6.32
B 8	BUS 22	-37.67	32.97
	Total:	-17.50	33.00

B 11	B 9	20.00	17.66
	Total:	20.00	17.66
B 13	B 12	20.00	18.84
	Total:	20.00	18.84
C 1	C 2	42.36	-5.33
C 1	C 3	53.49	12.61
C 1	BUS 92	4.15	27.38
	Total:	100.00	34.65
C 2	C 1	-42.05	3.38
C 2	C 4	53.71	9.91
C 2	C 5	44.20	8.25
C 2	C 6	63.58	6.42
C 2	BUS 89	-66.56	14.25
	Total:	52.87	42.22
C 5	C 2	-43.32	-6.75
C 5	C 7	21.98	4.10
C 5	BUS 85	-46.42	-1.20
	Total:	-67.75	-3.85
C 8	C 6	-26.75	20.42
C 8	C 28	4.98	3.27
C 8	BUS 83	4.27	9.31
	Total:	-17.50	33.00
C 11	C 9	20.00	14.89
	Total:	20.00	14.89
C 13	C 12	20.00	16.03
	Total:	20.00	16.03
D 1	D 2	-35.39	9.43
D 1	D 3	9.18	9.36
D 1	BUS 56	126.20	81.20
	Total:	100.00	100.00
D 2	D 1	35.64	-11.42

D 2	D 4	23.27	6.42
D 2	D 5	-23.24	10.24
D 2	D 6	17.21	5.62
Total:		52.87	10.86
D 5	D 2	23.55	-11.12
D 5	D 7	43.75	-.35
D 5	BUS 66	-135.05	-9.65
Total:		-67.75	-21.12
D 8	D 6	39.52	14.80
D 8	D 28	10.67	4.09
D 8	BUS 67	-67.70	14.10
Total:		-17.50	33.00
D 11	D 9	20.00	15.61
Total:		20.00	15.61
D 13	D 12	20.00	18.28
Total:		20.00	18.28
E 1	E 2	173.05	16.66
E 1	E 5	57.83	21.92
E 1	BUS 102	44.12	34.62
Total:		275.00	73.20
E 2	E 1	-167.78	-2.65
E 2	E 3	80.62	9.84
E 2	E 4	44.34	13.74
E 2	E 5	16.93	15.15
E 2	BUS 97	38.76	-3.86
Total:		12.88	32.22
E 3	E 2	-77.61	-1.45
E 3	E 4	-40.14	16.85
Total:		-117.75	15.40
E 6	E 11	11.32	8.70
E 6	E 12	10.19	4.03
E 6	E 13	23.47	12.20
E 6	E 5	-58.99	-1.44
Total:		-14.00	23.50

E 8	E 7	.00	23.98
	Total:	.00	23.98
BUS 2	BUS 1	15.78	4.00
BUS 2	BUS 12	-40.78	-16.58
	Total:	-25.00	-12.58
BUS 3	BUS 1	48.39	-3.10
BUS 3	BUS 5	-98.37	-12.87
BUS 3	BUS 12	-12.52	-12.02
	Total:	-62.50	-27.98
BUS 5	BUS 4	85.93	-8.87
BUS 5	BUS 3	100.96	21.77
BUS 5	BUS 6	137.48	3.28
BUS 5	BUS 11	109.07	6.75
BUS 5	BUS 8	-483.44	-88.02
BUS 5	BUS 5	.00	39.90
	Total:	-50.00	-25.19
BUS 7	BUS 6	-69.98	-13.05
BUS 7	BUS 12	6.22	-6.51
	Total:	-63.75	-19.55
BUS 9	BUS 8	562.29	20.04
BUS 9	BUS 10	-562.29	-20.03
	Total:	.00	.00
BUS 11	BUS 4	-96.26	-2.09
BUS 11	BUS 5	-106.64	-.26
BUS 11	BUS 12	72.45	-43.03
BUS 11	BUS 13	42.95	13.22
	Total:	-87.50	-32.16
BUS 13	BUS 11	-42.47	-13.39
BUS 13	BUS 15	-.03	-9.01
	Total:	-42.50	-22.40
BUS 14	BUS 12	-19.48	-4.67
BUS 14	BUS 15	1.98	-2.32
	Total:	-17.50	-6.99

BUS 16	BUS 12	-5.81	-7.01
BUS 16	BUS 17	-25.44	-6.98
Total:		-31.25	-13.99
BUS 17	BUS 15	135.55	16.43
BUS 17	BUS 16	25.77	3.76
BUS 17	BUS 18	108.75	16.71
BUS 17	BUS 31	24.73	7.97
BUS 17	BUS 113	12.40	.66
BUS 17	BUS 30	-320.96	-49.73
BUS 17	BUS 17	.00	.00
Total:		-13.75	-4.20
BUS 20	BUS 19	-24.19	40.82
BUS 20	BUS 21	34.16	23.41
BUS 20	B 1	-32.47	-74.02
Total:		-22.50	-9.80
BUS 21	BUS 20	-33.84	-24.09
BUS 21	BUS 22	-30.93	18.63
BUS 21	B 4	9.78	-15.55
Total:		-55.00	-21.00
BUS 22	BUS 21	31.23	-19.63
BUS 22	BUS 23	-125.75	34.63
BUS 22	B 8	38.27	-33.20
Total:		-56.25	-18.20
BUS 23	BUS 22	131.97	-9.57
BUS 23	BUS 24	-99.43	6.11
BUS 23	BUS 25	-214.93	-27.08
BUS 23	BUS 32	104.89	-8.66
Total:		-77.50	-39.20
BUS 28	BUS 27	-49.53	-1.27
BUS 28	BUS 29	28.28	-8.53
Total:		-21.25	-9.80
BUS 29	BUS 28	-28.06	7.23
BUS 29	BUS 31	-1.94	-26.83
Total:		-30.00	-19.60
BUS 30	BUS 8	-110.81	-80.18

BUS 30	BUS 26	-252.97	-31.61
BUS 30	BUS 38	42.81	20.62
BUS 30	BUS 17	320.96	91.17
Total:		.00	.00
BUS 33	BUS 15	5.27	-5.99
BUS 33	BUS 37	-34.02	-6.61
Total:		-28.75	-12.60
BUS 35	BUS 36	3.75	-11.76
BUS 35	BUS 37	-45.00	-14.84
Total:		-41.25	-26.60
BUS 37	BUS 35	45.26	14.73
BUS 37	BUS 33	34.55	4.91
BUS 37	BUS 34	143.86	16.54
BUS 37	BUS 39	32.12	9.78
BUS 37	BUS 40	19.51	2.65
BUS 37	BUS 38	-275.30	-73.08
BUS 37	BUS 37	.00	24.46
Total:		.00	.00
BUS 38	BUS 30	-42.64	-58.20
BUS 38	BUS 65	-232.66	-45.97
BUS 38	BUS 37	275.30	104.17
Total:		-.01	.00
BUS 39	BUS 37	-31.74	-11.11
BUS 39	BUS 40	-2.01	-4.29
Total:		-33.75	-15.40
BUS 41	BUS 40	-17.28	-6.90
BUS 41	BUS 42	-28.97	-7.10
Total:		-46.25	-14.00
BUS 43	BUS 44	-9.78	-7.07
BUS 43	BUS 34	-12.72	-2.73
Total:		-22.50	-9.80
BUS 44	BUS 43	9.85	1.46
BUS 44	BUS 45	-61.76	9.84
BUS 44	A 5	31.90	-12.62
BUS 44	BUS 44	.00	-9.88
Total:		-20.00	-11.20

BUS 45	BUS 44	62.65	-8.47
BUS 45	BUS 46	-77.53	-24.83
BUS 45	BUS 49	-75.84	18.41
BUS 45	A 2	-13.03	-38.11
BUS 45	BUS 45	.00	-9.99
Total:		-103.75	-63.00

BUS 47	BUS 46	20.78	-49.14
BUS 47	BUS 49	-36.71	-7.41
BUS 47	BUS 69	-64.07	14.55
Total:		-80.00	-42.00

BUS 48	BUS 46	6.62	-22.58
BUS 48	BUS 49	-68.05	42.17
BUS 48	A 1	36.43	-18.98
BUS 48	BUS 48	.00	-16.02
Total:		-25.00	-15.40

BUS 50	BUS 49	-53.34	-9.96
BUS 50	BUS 57	32.09	4.36
Total:		-21.25	-5.60

BUS 51	BUS 49	-60.66	-12.47
BUS 51	BUS 52	34.13	8.28
BUS 51	BUS 58	17.08	.11
BUS 51	D 4	-11.80	-7.12
Total:		-21.25	-11.20

BUS 52	BUS 51	-33.87	-8.83
BUS 52	BUS 53	11.37	1.83
Total:		-22.50	-7.00

BUS 53	BUS 52	-11.31	-5.31
BUS 53	BUS 54	-17.44	-10.09
Total:		-28.75	-15.40

BUS 57	BUS 56	16.58	2.01
BUS 57	BUS 50	-31.58	-6.21
Total:		-15.00	-4.20

BUS 58	BUS 56	2.00	-2.61

BUS 58	BUS 51	-17.00	-1.59
Total:		-15.00	-4.20
BUS 60	BUS 59	43.27	-8.86
BUS 60	BUS 61	-140.68	-34.54
BUS 60	BUS 62	-.10	-16.79
Total:		-97.50	-60.20
BUS 63	BUS 64	-183.15	-63.88
BUS 63	BUS 59	183.15	63.88
Total:		.00	.00
BUS 64	BUS 63	183.82	51.17
BUS 64	BUS 65	-271.18	-58.66
BUS 64	BUS 61	87.36	7.48
Total:		.00	.00
BUS 67	BUS 62	-.94	13.25
BUS 67	BUS 66	-102.85	-11.32
BUS 67	D 8	68.79	-11.72
Total:		-35.00	-9.80
BUS 68	BUS 65	117.07	-45.32
BUS 68	BUS 81	-119.90	36.11
BUS 68	BUS 116	.03	-94.73
BUS 68	BUS 69	2.80	103.94
Total:		.00	.00
BUS 71	BUS 70	40.54	-1.26
BUS 71	BUS 72	-3.66	2.72
BUS 71	BUS 73	-36.88	-1.46
Total:		.00	.00
BUS 75	BUS 70	-12.54	-13.97
BUS 75	BUS 69	-113.60	-15.66
BUS 75	BUS 74	54.99	-19.73
BUS 75	BUS 77	-62.91	-1.22
BUS 75	BUS 118	34.06	15.58
Total:		-100.00	-35.00
BUS 78	BUS 77	-40.28	-32.93
BUS 78	BUS 79	-48.47	-3.47
Total:		-88.75	-36.40

BUS 79	BUS 78	48.60	3.39
BUS 79	BUS 80	-97.35	-28.03
BUS 79	BUS 79	.00	-20.16
Total:		-48.75	-44.80
BUS 81	BUS 68	120.20	-65.84
BUS 81	BUS 80	-120.20	65.84
Total:		.00	.00
BUS 82	BUS 77	42.88	-31.01
BUS 82	BUS 83	-44.80	-3.56
BUS 82	BUS 96	-46.39	10.25
BUS 82	C 28	-19.19	6.22
BUS 82	BUS 82	.00	-19.70
Total:		-67.50	-37.80
BUS 83	BUS 82	45.03	3.17
BUS 83	BUS 84	-25.08	4.02
BUS 83	BUS 85	-40.69	-1.43
BUS 83	C 8	-4.26	-9.78
BUS 83	BUS 83	.00	-9.97
Total:		-25.00	-14.00
BUS 84	BUS 83	25.42	-5.76
BUS 84	BUS 85	-39.17	-4.04
Total:		-13.75	-9.80
BUS 86	BUS 85	-22.25	3.64
BUS 86	BUS 87	-4.00	-17.64
Total:		-26.25	-14.00
BUS 88	BUS 85	77.79	-13.45
BUS 88	BUS 89	-137.79	-21.55
Total:		-60.00	-35.00
BUS 93	BUS 92	-61.82	-7.98
BUS 93	BUS 94	46.82	-1.82
Total:		-15.00	-9.80
BUS 94	BUS 92	-54.46	-3.41
BUS 94	BUS 93	-46.34	1.52
BUS 94	BUS 95	68.71	6.49

BUS 94	BUS 96	51.95	-11.80
BUS 94	BUS 100	-57.37	-15.20
Total:		-37.50	-22.40
BUS 95	BUS 94	-68.08	-5.51
BUS 95	BUS 96	27.00	-23.55
BUS 95	C 4	-11.42	-14.35
Total:		-52.50	-43.40
BUS 96	BUS 80	-3.20	-26.71
BUS 96	BUS 82	46.76	-10.67
BUS 96	BUS 94	-51.19	11.97
BUS 96	BUS 95	-26.78	22.81
BUS 96	BUS 97	-13.08	-18.39
Total:		-47.50	-21.00
BUS 97	BUS 80	6.52	-32.79
BUS 97	BUS 96	13.17	16.40
BUS 97	E 2	-38.44	3.79
Total:		-18.75	-12.60
BUS 98	BUS 80	-25.24	-55.83
BUS 98	BUS 100	-54.76	-11.37
Total:		-80.00	-67.20
BUS 101	BUS 100	5.54	-5.93
BUS 101	BUS 102	-33.04	-15.07
Total:		-27.50	-21.00
BUS 102	BUS 92	-20.80	16.45
BUS 102	BUS 101	33.35	13.37
BUS 102	E 1	-43.80	-34.02
Total:		-31.25	-4.20
BUS 105	BUS 103	-42.01	-14.43
BUS 105	BUS 104	-38.43	-37.31
BUS 105	BUS 106	22.06	22.49
BUS 105	BUS 107	-1.63	-2.40
BUS 105	BUS 108	21.25	2.12
BUS 105	BUS 105	.00	-18.07
Total:		-38.75	-47.60
BUS 106	BUS 100	-56.05	-18.48
BUS 106	BUS 105	-21.90	-23.15

BUS 106	BUS 107	-8.30	-8.78
Total:		-86.25	-50.40
BUS 108	BUS 105	-21.12	-3.41
BUS 108	BUS 109	18.62	2.01
Total:		-2.50	-1.40
BUS 109	BUS 108	-18.58	-2.57
BUS 109	BUS 110	-41.42	-11.43
Total:		-60.00	-14.00
BUS 110	BUS 103	-31.53	-14.03
BUS 110	BUS 109	42.00	11.18
BUS 110	BUS 111	-35.66	-14.11
BUS 110	BUS 112	-23.57	-12.64
BUS 110	BUS 110	.00	-5.54
Total:		-48.75	-35.14
BUS 113	BUS 17	-12.39	-1.37
BUS 113	BUS 32	4.89	10.33
Total:		-7.50	8.96
BUS 114	BUS 32	-6.33	-13.54
BUS 114	BUS 115	-18.67	9.34
Total:		-25.00	-4.20
BUS 115	BUS 27	-62.43	-4.46
BUS 115	BUS 114	18.68	-9.54
Total:		-43.75	-14.00
BUS 117	BUS 12	-25.00	-11.19
Total:		-25.00	-11.19
BUS 118	BUS 75	-33.83	-15.93
BUS 118	BUS 76	-7.42	-5.07
Total:		-41.25	-21.00
A 3	A 1	-49.32	-11.59
A 3	A 4	46.32	9.91
Total:		-3.00	-1.68

A 4	A 2	-34.97	-12.25
A 4	A 3	-46.02	-10.35
A 4	A 6	35.77	1.84
A 4	A 12	35.72	18.52
Total:		-9.50	-2.24

A 6	A 2	-42.68	-11.57
A 6	A 4	-35.62	-1.75
A 6	A 7	21.75	3.20
A 6	A 8	21.52	-3.08
A 6	A 28	-.23	10.97
A 6	A 9	19.92	-1.79
A 6	A 10	15.34	4.01
Total:		.00	.00

A 7	A 5	-6.89	-9.88
A 7	A 6	-21.61	-5.38
Total:		-28.50	-15.26

A 9	A 11	-20.00	-15.92
A 9	A 10	39.92	13.32
A 9	A 6	-19.92	2.61
Total:		.00	.00

A 10	A 9	-39.92	-11.43
A 10	A 20	11.26	4.39
A 10	A 17	6.88	5.08
A 10	A 21	20.11	14.33
A 10	A 22	9.77	6.64
A 10	A 6	-15.34	-2.67
A 10	A 10	.00	-19.13
Total:		-7.25	-2.80

A 12	A 13	-20.00	-16.88
A 12	A 14	9.99	4.39
A 12	A 15	22.84	10.99
A 12	A 16	8.89	5.88
A 12	A 4	-35.72	-14.88
Total:		-14.00	-10.50

A 14	A 12	-9.85	-4.10
A 14	A 15	2.10	1.86
Total:		-7.75	-2.24

A 15	A 12	-22.43	-10.20

A 15	A 14	-2.09	-1.84
A 15	A 18	7.62	3.14
A 15	A 23	6.66	5.40
	Total:	-10.25	-3.50
A 16	A 12	-8.79	-5.67
A 16	A 17	4.42	3.15
	Total:	-4.38	-2.52
A 17	A 16	-4.39	-3.09
A 17	A 10	-6.86	-5.03
	Total:	-11.25	-8.12
A 18	A 15	-7.54	-2.99
A 18	A 19	3.54	1.73
	Total:	-4.00	-1.26
A 19	A 18	-3.53	-1.71
A 19	A 20	-8.34	-3.05
	Total:	-11.87	-4.76
A 20	A 19	8.37	3.10
A 20	A 10	-11.12	-4.08
	Total:	-2.75	-.98
A 21	A 10	-19.90	-13.88
A 21	A 22	-1.98	-1.80
	Total:	-21.87	-15.68
A 22	A 10	-9.67	-6.43
A 22	A 21	1.98	1.81
A 22	A 24	7.69	4.63
	Total:	.00	.00
A 23	A 15	-6.59	-5.25
A 23	A 24	2.59	3.01
	Total:	-4.00	-2.24
A 24	A 22	-7.60	-4.48
A 24	A 23	-2.57	-2.97
A 24	A 25	-.71	1.82
A 24	A 24	.00	-3.75

	Total:	-10.87	-9.38
A 25	A 24	.72	-1.81
A 25	A 26	4.44	3.35
A 25	A 27	-5.16	-1.54
	Total:	.00	.00
A 26	A 25	-4.37	-3.22
	Total:	-4.37	-3.22
A 27	A 25	5.20	1.60
A 27	A 29	7.84	3.63
A 27	A 30	8.99	4.17
A 27	A 28	-22.02	-9.41
	Total:	.00	.00
A 28	A 6	.25	-11.53
A 28	A 8	4.40	-5.07
A 28	BUS 42	-26.67	4.80
A 28	A 27	22.02	11.81
	Total:	.00	.00
A 29	A 27	-7.66	-3.30
A 29	A 30	4.66	2.04
	Total:	-3.00	-1.26
A 30	A 27	-8.66	-3.55
A 30	A 29	-4.59	-1.91
	Total:	-13.25	-5.46
B 3	B 1	-25.13	-19.60
B 3	B 4	22.13	17.93
	Total:	-3.00	-1.68
B 4	B 2	-19.26	-22.55
B 4	B 3	-22.02	-18.90
B 4	B 6	8.18	7.83
B 4	BUS 21	-9.70	13.29
B 4	B 12	33.30	18.09
	Total:	-9.50	-2.24
B 6	B 2	-20.92	-23.90

B 6	B 4	-8.16	-8.21
B 6	B 7	45.80	-4.77
B 6	B 8	-23.65	6.11
B 6	B 28	-29.14	28.64
B 6	B 9	20.44	-1.90
B 6	B 10	15.63	4.03
	Total:	.00	.00

B 7	B 5	16.72	-19.20
B 7	B 6	-45.22	3.94
	Total:	-28.50	-15.26

B 9	B 11	-20.00	-16.32
B 9	B 10	40.44	13.56
B 9	B 6	-20.44	2.76
	Total:	.00	.00

B 10	B 9	-40.44	-11.62
B 10	B 20	11.72	4.23
B 10	B 17	7.85	4.71
B 10	B 21	19.73	14.71
B 10	B 22	9.52	6.90
B 10	B 6	-15.63	-2.64
B 10	B 10	.00	-19.09
	Total:	-7.25	-2.80

B 12	B 13	-20.00	-17.88
B 12	B 14	9.67	4.52
B 12	B 15	21.72	11.48
B 12	B 16	7.91	6.23
B 12	B 4	-33.30	-14.85
	Total:	-14.00	-10.50

B 14	B 12	-9.53	-4.25
B 14	B 15	1.78	2.01
	Total:	-7.75	-2.24

B 15	B 12	-21.34	-10.74
B 15	B 14	-1.78	-1.99
B 15	B 18	7.16	3.30
B 15	B 23	5.71	5.92
	Total:	-10.25	-3.50

B 16	B 12	-7.82	-6.04
B 16	B 17	3.45	3.52
	Total:	-4.37	-2.52

B 17	B 16	-3.43	-3.47
B 17	B 10	-7.82	-4.65
	Total:	-11.25	-8.12
B 18	B 15	-7.09	-3.17
B 18	B 19	3.09	1.91
	Total:	-4.00	-1.26
B 19	B 18	-3.08	-1.89
B 19	B 20	-8.79	-2.87
	Total:	-11.87	-4.76
B 20	B 19	8.82	2.93
B 20	B 10	-11.57	-3.91
	Total:	-2.75	-.98
B 21	B 10	-19.52	-14.26
B 21	B 22	-2.36	-1.42
	Total:	-21.87	-15.68
B 22	B 10	-9.42	-6.69
B 22	B 21	2.36	1.42
B 22	B 24	7.06	5.27
	Total:	.00	.00
B 23	B 15	-5.64	-5.79
B 23	B 24	1.64	3.55
	Total:	-4.00	-2.24
B 24	B 22	-6.97	-5.12
B 24	B 23	-1.62	-3.50
B 24	B 25	-2.28	2.99
B 24	B 24	.00	-3.74
	Total:	-10.87	-9.38
B 25	B 24	2.31	-2.94
B 25	B 26	4.44	3.35
B 25	B 27	-6.75	-.41
	Total:	.00	.00

B 26	B 25	-4.37	-3.22
	Total:	-4.37	-3.22
B 27	B 25	6.81	.51
B 27	B 29	7.84	3.64
B 27	B 30	8.99	4.18
B 27	B 28	-23.64	-8.33
	Total:	.00	.00
B 28	B 6	29.43	-28.23
B 28	B 8	3.60	-8.25
B 28	BUS 32	-56.67	25.52
B 28	B 27	23.64	10.97
	Total:	.00	.00
B 29	B 27	-7.67	-3.31
B 29	B 30	4.67	2.05
	Total:	-3.00	-1.26
B 30	B 27	-8.66	-3.55
B 30	B 29	-4.59	-1.91
	Total:	-13.25	-5.46
C 3	C 1	-52.24	-9.64
C 3	C 4	49.24	7.96
	Total:	-3.00	-1.68
C 4	C 2	-52.11	-10.99
C 4	C 3	-48.91	-8.32
C 4	C 6	43.25	-15.20
C 4	BUS 95	11.48	13.62
C 4	C 12	36.79	18.65
	Total:	-9.50	-2.24
C 6	C 2	-61.38	-5.79
C 6	C 4	-43.00	15.62
C 6	C 7	6.78	4.71
C 6	C 8	26.89	-20.40
C 6	C 28	34.92	.92
C 6	C 9	20.23	.18
C 6	C 10	15.56	4.76
	Total:	.00	.00

C 7	C 5	-21.75	-7.97
C 7	C 6	-6.75	-7.29
Total:		-28.50	-15.26

C 9	C 11	-20.00	-13.72
C 9	C 10	40.23	13.08
C 9	C 6	-20.23	.64
Total:		.00	.00

C 10	C 9	-40.23	-11.19
C 10	C 20	11.16	4.74
C 10	C 17	6.54	5.79
C 10	C 21	20.69	14.08
C 10	C 22	10.15	6.47
C 10	C 6	-15.56	-3.37
C 10	C 10	.00	-19.32
Total:		-7.25	-2.80

C 12	C 13	-20.00	-15.19
C 12	C 14	10.16	4.17
C 12	C 15	23.41	10.21
C 12	C 16	9.23	5.16
C 12	C 4	-36.79	-14.85
Total:		-14.00	-10.50

C 14	C 12	-10.02	-3.88
C 14	C 15	2.27	1.64
Total:		-7.75	-2.24

C 15	C 12	-23.00	-9.41
C 15	C 14	-2.26	-1.62
C 15	C 18	7.71	2.78
C 15	C 23	7.30	4.74
Total:		-10.25	-3.50

C 16	C 12	-9.13	-4.95
C 16	C 17	4.76	2.43
Total:		-4.37	-2.52

C 17	C 16	-4.73	-2.38
C 17	C 10	-6.52	-5.74
Total:		-11.25	-8.12

C 18	C 15	-7.64	-2.64

C 18	C 19	3.64	1.38
	Total:	-4.00	-1.26
C 19	C 18	-3.63	-1.36
C 19	C 20	-8.25	-3.40
	Total:	-11.87	-4.76
C 20	C 19	8.28	3.46
C 20	C 10	-11.03	-4.44
	Total:	-2.75	-.98
C 21	C 10	-20.47	-13.62
C 21	C 22	-1.40	-2.06
	Total:	-21.87	-15.68
C 22	C 10	-10.05	-6.26
C 22	C 21	1.40	2.07
C 22	C 24	8.65	4.19
	Total:	.00	.00
C 23	C 15	-7.22	-4.59
C 23	C 24	3.22	2.35
	Total:	-4.00	-2.24
C 24	C 22	-8.54	-4.03
C 24	C 23	-3.20	-2.31
C 24	C 25	.86	.74
C 24	C 24	.00	-3.79
	Total:	-10.87	-9.38
C 25	C 24	-.86	-.74
C 25	C 26	4.44	3.35
C 25	C 27	-3.58	-2.60
	Total:	.00	.00
C 26	C 25	-4.37	-3.22
	Total:	-4.37	-3.22
C 27	C 25	3.60	2.65
C 27	C 29	7.83	3.63
C 27	C 30	8.98	4.17
C 27	C 28	-20.42	-10.44

	Total:	.00	.00
C 28	C 6	-34.71	-.83
C 28	C 8	-4.95	-5.31
C 28	BUS 82	19.24	-6.47
C 28	C 27	20.42	12.61
	Total:	.00	.00
C 29	C 27	-7.66	-3.30
C 29	C 30	4.66	2.04
	Total:	-3.00	-1.26
C 30	C 27	-8.66	-3.55
C 30	C 29	-4.59	-1.91
	Total:	-13.25	-5.46
D 3	D 1	-9.10	-11.09
D 3	D 4	6.10	9.41
	Total:	-3.00	-1.68
D 4	D 2	-22.92	-11.13
D 4	D 3	-6.08	-10.63
D 4	D 6	-23.93	-2.70
D 4	BUS 51	11.88	5.27
D 4	D 12	31.55	16.96
	Total:	-9.50	-2.24
D 6	D 2	-17.00	-10.88
D 6	D 4	24.00	2.50
D 6	D 7	-14.29	11.31
D 6	D 8	-39.31	-14.51
D 6	D 28	7.73	7.46
D 6	D 9	22.21	-.42
D 6	D 10	16.67	4.55
	Total:	.00	.00
D 7	D 5	-42.89	-1.62
D 7	D 6	14.39	-13.64
	Total:	-28.50	-15.26
D 9	D 11	-20.00	-14.40
D 9	D 10	42.21	12.98
D 9	D 6	-22.21	1.41
	Total:	.00	.00

D 10	D 9	-42.21	-10.92
D 10	D 20	12.33	4.43
D 10	D 17	8.83	5.14
D 10	D 21	20.47	14.23
D 10	D 22	10.01	6.57
D 10	D 6	-16.67	-2.97
D 10	D 10	.00	-19.27
	Total:	-7.25	-2.80

D 12	D 13	-20.00	-17.34
D 12	D 14	9.50	4.33
D 12	D 15	21.14	10.82
D 12	D 16	6.92	5.75
D 12	D 4	-31.55	-14.06
	Total:	-14.00	-10.50

D 14	D 12	-9.37	-4.06
D 14	D 15	1.62	1.82
	Total:	-7.75	-2.24

D 15	D 12	-20.78	-10.12
D 15	D 14	-1.62	-1.81
D 15	D 18	6.55	3.12
D 15	D 23	5.60	5.31
	Total:	-10.25	-3.50

D 16	D 12	-6.84	-5.60
D 16	D 17	2.47	3.08
	Total:	-4.37	-2.52

D 17	D 16	-2.46	-3.05
D 17	D 10	-8.79	-5.07
	Total:	-11.25	-8.12

D 18	D 15	-6.49	-3.01
D 18	D 19	2.49	1.75
	Total:	-4.00	-1.26

D 19	D 18	-2.49	-1.73
D 19	D 20	-9.39	-3.03
	Total:	-11.88	-4.76

D 20	D 19	9.42	3.09
D 20	D 10	-12.17	-4.07
	Total:	-2.75	-.98
D 21	D 10	-20.25	-13.77
D 21	D 22	-1.62	-1.91
	Total:	-21.88	-15.68
D 22	D 10	-9.90	-6.36
D 22	D 21	1.62	1.91
D 22	D 24	8.28	4.45
	Total:	.00	.00
D 23	D 15	-5.54	-5.19
D 23	D 24	1.54	2.95
	Total:	-4.00	-2.24
D 24	D 22	-8.18	-4.29
D 24	D 23	-1.52	-2.92
D 24	D 25	-1.18	1.60
D 24	D 24	.00	-3.78
	Total:	-10.87	-9.38
D 25	D 24	1.18	-1.59
D 25	D 26	4.44	3.35
D 25	D 27	-5.63	-1.75
	Total:	.00	.00
D 26	D 25	-4.38	-3.22
	Total:	-4.38	-3.22
D 27	D 25	5.67	1.83
D 27	D 29	7.83	3.63
D 27	D 30	8.98	4.16
D 27	D 28	-22.48	-9.62
	Total:	.00	.00
D 28	D 6	-7.71	-8.03
D 28	D 8	-10.58	-5.95
D 28	BUS 59	-4.19	1.89
D 28	D 27	22.48	12.09
	Total:	.00	.00

D 29	D 27	-7.66	-3.30
D 29	D 30	4.66	2.04
Total:		-3.00	-1.26
D 30	D 27	-8.66	-3.55
D 30	D 29	-4.59	-1.91
Total:		-13.25	-5.46
E 4	E 2	-43.10	-13.66
E 4	E 3	41.54	-16.53
E 4	E 5	-109.97	9.72
E 4	E 7	32.99	-8.66
E 4	E 9	18.79	1.13
Total:		-59.75	-28.00
E 5	E 1	-55.91	-19.09
E 5	E 2	-16.61	-17.58
E 5	E 4	111.71	-5.44
E 5	BUS 90	-107.68	30.28
E 5	E 6	58.99	9.59
Total:		-9.50	-2.24
E 7	E 8	.00	-23.06
E 7	E 9	32.99	11.91
E 7	E 4	-32.99	11.15
Total:		.00	.00
E 9	E 7	-32.99	-10.58
E 9	E 10	4.55	2.49
E 9	E 14	10.36	2.92
E 9	E 4	-18.79	.85
E 9	E 9	.00	-18.90
Total:		-36.87	-23.24
E 10	E 9	-4.54	-2.46
E 10	E 11	-6.71	-5.66
Total:		-11.25	-8.12
E 11	E 6	-11.14	-8.33
E 11	E 10	6.77	5.81
Total:		-4.38	-2.52

E 12	E 6	-10.05	-3.75
E 12	E 13	2.43	1.51
Total:		-7.63	-2.24

E 13	E 6	-23.04	-11.36
E 13	E 12	-2.41	-1.49
E 13	E 14	8.58	4.73
Total:		-16.88	-8.12

E 14	E 9	-10.21	-2.60
E 14	E 13	-8.42	-4.40
Total:		-18.62	-7.00

System losses:	249.95	-12.44
R*I**2,X*I**2:	249.95	1423.70

E-21-615

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December 13, 1985

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Dear Monsieur Lehmann:

Enclosed, please find the final report entitled, "Computational Cycle Time Evaluation for Steady State Power Flow Calculations".

Sincerely,

H. B. Puttgen, Ph.D.

HBP/mjc

Enclosure

COMPUTATIONAL CYCLE TIME EVALUATION FOR STEADY STATE POWER FLOW CALCULATIONS

Prepared for

Thomson-CSF, Division Simulateurs

by

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1. INTRODUCTION

The main purpose of this project is to provide an estimation of the basic computational cycle time required for a real time power network simulator. Such a simulator would be based on two main software blocks:

- a dynamic module simulating the various regulators present in the network.

- a steady state load flow to determine the exact state of the system a regular time intervals following the actions of the requlators, following external random events, and following various control actions taken by the student dispatcher.

The bulk of the computational cycle time will be taken by the load flow soluton procedure. Therefore, this project will be centered around the estimation of the required CPU times to carry out various steady state solutions.

Chapter 2 of this report provides a brief description of the load flow program used for this project. Primary emphasis is put on the input output formats of program FDLF Version 100.

A validation of program FDLF is provided in Chapter 3 using the raw data from the so-called IEEE 118 Bus Test Network.

A special 250 Bus Network was constructed to carry out the cycle time tests. The actual construction procedure for this network, which is based on the IEEE 118 Bus, IEEE 30 Bus, and IEEE 14 Bus Networks, is discussed in Chapter 4. In Chapter 4, the three different base case load and generation situations are also presented.

Chapter 5 actually presents the required CPU cycle times for the three base cases and for four separate contingencies for each of the three base cases. As a result, a total of 15 load flow solutions are presented and discussed. In addition, the influence of the convergence test accuracy on the solution time is investigated along with the influence of the transmission line X/R ratio. Finally, the combined effect of these two parameters is discussed.

Finally, in Chapter 6, two benchmark programs are presented which will enable a comparison of the computational speed of Georgia Tech's CDC CYBER 180/855, used for this project, with that of other computers.

2. LOAD FLOW PROGRAM

The load flow program used for the purposes of this project is called FDLF version 100. FDLF has the following features:

- Uses the so-called Fast Decoupled Load Flow formulation first proposed by Stott and Alsac. This means that only the "diagonal" Jacobian submatrices:

$$\partial P/\partial \delta \text{ and } \partial Q/\partial V$$

are retained while the "off diagonal" Jacobian submatrices:

$$\partial P/\partial V \text{ and } \partial Q/\partial \delta$$

are set to zero.

Furthermore, the two "diagonal" Jacobian submatrices are kept at their constant values throughout the solution procedure such that:

$$\partial P/\partial \delta = B' \text{ and } \partial Q/\partial V = B''$$

- Uses an optimum storage technique to minimize the "filling" process during the Gaussian elimination procedure.

- The solution of each of the two decoupled sets of linear equations at each iteration is done by forward-backward substitutions.

- The trigonometric functions required during the load flow formulations are explicitely coded in the program using limited Taylor expansion series rather than relying on Fortran Library functions.

- FDLF is coded in Fortran 77 and is running on a CDC CYBER 180/855 for the purposes of this study. The Fortran compiler optimizer option was used to minimize the required execution time.

2.1. Inputs Required

Program FDLF uses the following input structure, where all data is entered in the so-called free format:

Record 1: General bus data information

NN: number of nodes
NG: number of generator buses (PV buses)
SBASE: base MVA, generally set to 100
EPSP: absolute mismatch error allowed on real powers
EPSQ: absolute mismatch error allowed on reactive powers

Record 2: Slack bus data

Bus Name, in alphanumeric format
VS: slack bus voltage magnitude, in pu
θS: slack bus phase angle, in degrees

Records 3 to NG+2: Generator (PV) bus data

Bus Name, in alphanumeric format
PG: real power generation, in MW
QGMIN: minimum reactive power generation limit, in MVAR
QGMAX: maximum reactive power generation limit, in MVAR
PD: real power demand, in MW
QD: reactive power demand, in MVAR
VSPEC: specified voltage magnitude, in pu

Records NG+3 to NN+1: Load bus data

Bus Name, in alphanumeric format
PD: real power demand, in MW
QD: reactive power demand, in MVAR

Record NN+2: General element data information

NL: number of transmission lines
NT: number of transformers
NS: number of shunt elements

Records NN+3 to NN+NL+2: Transmission line data

Starting Bus Name, in alphanumeric format
Ending Bus Name, in alphanumeric format
RL: transversal resistance, in %, based on SBASE
XL: transversal reactance, in %, based on SBASE
QC: total charging reactive power for the line at 1 pu voltage at both ends

Records NN+NL+3 to NN+NL+NT+2: Transformer data

Starting Bus Name, in alphanumeric format
Ending Bus Name, in alphanumeric format
RT: short circuit resistane, in %, based on SBASE, and referred to the starting bus side
XT: short circuit reactance, in %, based on SBASE and referred to the starting bus side
TAP: turns ratio of the transformer expressed as the ratio of the no-load starting bus voltage to the no-load ending bus voltage.

Records NN+NL+NT+3 to NN+NL+NT+NS+2: Shunt Element Data

Bus Name, in alphanumeric format
XS: shunt reactance, given as the reactive power injected into the network by the device at 1 pu voltage (positive for capacitive devices, negative for inductive devices).

2.2 Output Obtained

Using the IEEE 30 bus network as an example, the three major output listings yielded by program FDLF can be described as follows, where the three listings are contained in Appendix A.

2.2.1 Element Data

This listing is separated in three subparts:

Transmission Lines

NO: Starting Bus Name
NE: Ending Bus Name
R: Transversal resistance, in %, based on SBASE
X: Transversal reactance, in %, based on SBASE
X/R: Ratio provided for comparative purposes
wC: Based on the charging reactive power for the line at 1 pu voltage at both ends
Length: Based on EPRI typical data; see Appendix B

Transformers

NO: Starting Bus Name
NE: Ending Bus Name
R: Short circuit resistance, in %, based on SBASE and referred to the starting bus side
X: Short circuit reactance, in %, based on SBASE and referred to the starting bus side
Tap: turns ratio of the transformer expressed as the ratio of the no-load starting bus voltage to the no-load ending bus voltage.

Shunt Elements

NO: Bus Name
wC: Based on the reactive power injection of the device at 1 pu voltage.

2.2.2 Bus Oriented Results

The second output listing is oriented toward the bus results. Initially, some global convergence results are provided:

Time for input: CPU time required to actually read the inputs from a sequential input file and to store the data into the appropriate arrays. This time is of no consequence to this project since it is highly machine dependent and no effort was expended to minimize it, for example, by use of various data base structures.

Time for compact: CPU time required to carry out the various compaction processes required to minimize the storage requirements. This time is only required once per load-flow solution before the actual iterative solution procedure is started.

Time for factorization: CPU time required to carry out the actual factorizaton and storage of the two decoupled Jacobian submatrices B' and B". This time is only required once per load-flow solution before the actual iterative solution procedure is started.

Number of iterations: Total number of iterations required to achieve the desired accuracy. Note that one solution of the B' and B" equations constitutes one iteration.

Maximum mismatch in PU: Maximum real and reactive power mismatches reached at any bus at the solution point.

Time for solution: CPU time required for the iterative solution procedure itself.

Execution time: Sum of all CPU times listed up to this point.

Next, the actual bus data results are listed:

Slack Bus Results:
Bus Name:
Voltage: magnitude, in pu, and phase angle, in degrees
Generation: PG and QG at the slack bus, in MW and MVAR

PV Bus Results:

Bus Name:

VSP: specified voltage, in pu

Voltage: magnitude, in pu, and phase angle, in degrees. Note that if the upper reactive power limit has been hit, then the voltage magnitude has a + attached to it; if the lower reactive power unit has been hit, then a - is attached to the voltage magnitude

Generation: PG, as specified, in MW
QG, as computed, in MVAR

QGmin, QGmax: as specified, in MVAR

Load: PD and QD as specified, in MW and MVAR

Load Bus Results

Bus Name:

Voltage: Magnitude, in pu, and phase angle, in degrees.

Load: PD and QD as specified, in MW and MVAR

Finally, some global results are given:

Power Generated: Sum of all real and reactive power generations, in MW and MVAR

Power Demanded: Sum of all real and reactive power demands, in MW and MVAR

System Losses: Real and reactive total system losses for the entire system. Note that a negative reactive power loss corresponds to a net reactive power production by the system.

Printout Time: CPU time required to generate all three printout files. Again, this time is of no consequence for the project on hand.

2.2.3 Line Flow Results

The last output listing gives all line flows related to each bus in a sequential order starting with the slack bus, then all PV buses, and finally all load buses.

Note that a shunt element is noted as having the same starting and ending bus name.

Net real and reactive power injections (in MW and MVar), as determined from the line flows, are given as well.

Finally, the system real and reactive power losses are again determined along with the actual losses in the transversal admittance elements.

3. LOAD FLOW PROGRAM VALIDATION

In an effort to provide an illustration of Program FDLF's capabilities, the IEEE 118 Bus Network was simulated. In this case, the exact original data, as originally proposed by American Electric Power, AEP, was used. This same network will then be used as the basis for the building of the 250-bus test network to be used for this project.

The actual data originally provided by AEP, and which was later used to "normalize" the IEEE 118 bus case, is attached in Appendix C. It should be noted that since this data is very old, the so-called Gauss-Seidel solution procedure was used and which explains the rather high number of buses with significant mismatches even at the solution point.

The results obtained using the FDLF program are attached in Appendix D. As will be obvious from a rapid inspection, the two sets of results coincide exactly once the computational errors are taken into account. The two best summaries of overall concordance probably are the real and reactive power system losses:

	AEP	FDLF
P_{Loss}	132.9	132.5
"Q_{Loss}" (X*I*I)	784.7	781.3

and the slack bus real and reactive power generations (BUS 69):

	AEP	FDLF
P_{Slack}	518.5	513.5
Q_{Slack}	-82.7	-82.40

4. 250 BUS SYSTEM

The required 250 bus test system was constructed using three different IEEE test networks:

IEEE 118 bus network (see Appendix D)

IEEE 30 bus network (see Appendix A)

IEEE 14 bus network (see Appendix E)

4.1 Interconnection Between Subsystems

Using the EPRI standarized line element values for various voltage levels, and the X/R ratios for the various lines in all three IEEE networks, the following conclusions can be reached:

- The IEEE 118 bus network primarily contains transmission lines at the 345 KV level and at the 115-165 KV level.

- The IEEE 30 bus network primarily contains transmission lines at the 115-165 KV level and at the 33 KV level.

- The IEEE 14 bus network primarily contains transmission lines at the 115-165 KV level and at the 33 KV level.

As a result, the HV portions of the IEEE 30 and IEEE 14 bus networks can be connected with the LV portion of the IEEE 118 bus network.

The final 250 bus system was then constructed as follows:

- The basic IEEE 118 bus system, in which the buses are named BUS 1 through BUS 118. BUS 69 remains the overall system slack bus.

- Four separate IEEE 30 bus networks, in which the buses are named A1 through A30, B1 through B30, C1 through C30, D1 through D30 respectively. Clearly, for each of these networks, the slack bus has been converted into a PV bus.

- One IEEE 14 bus network in which the buses are named E1 through E14. Clearly, the related slack bus has been converted into a PV bus.

Each of these systems, as they are modified, are discussed in the next six subsections as far as their bus models are concerned.

4.1.1 IEEE 118 Bus Network

The IEEE 118 bus system has 50 PV buses in its version used for the 250 bus network. Of these 50 PV buses, 18 are strictly reactive power regulators, i.e, their real power generation is set to zero. Finally, of the remaining 32 generator buses, four may have negative

real power generations to actually simulate a pump/turbine situation. The number of negative real power generations was significantly reduced from the original IEEE 118 bus case in an effort to arrive at a more realistic network.

In addition, a number of specified voltage magnitudes, VSPEC, were changed with respect to the original IEEE 118 bus data, again to arrive at a more realistic situation.

All real and reactive power demands were kept at their original values as contained in the original IEEE 118 bus data.

4.1.2 IEEE 30 Bus Network A

The A subsystem has 6 true generator buses modeled as PV buses.

In an effort to achieve a more realistic overall network, some of the specified voltage magnitude VSPEC, and power generation data have been modified in conjunction with the 250 Bus Network.

The HV portion of system A is connected to the LV portion of the main system as follows:

A1 - BUS 48
A8 - BUS 40
A2 - BUS 45
A28 - BUS 42
A5 - BUS 44

4.1.3 IEEE 30 Bus Network B

The B subsystem has 6 true generator buses modeled as PV buses

In an effort to achieve a more realistic overall network, some of the specified voltage magnitudes, VSPEC, and power generation data have been modified in conjunction with the 250 Bus Network.

The HV portion of system B is connected to the LV portion of the main system as follows:

B1 - BUS 20
B4 - BUS 21
B8 - BUS 22
B28 - BUS 32

4.1.4 IEEE 30 Bus Network C

The C subsystem has 6 true generator buses modeled on PV buses.

In an effort to achieve a more realistic overall network, some of the specified voltage magnitudes, VSPEC, and power generation data have been modified in conjunction with the 250 Bus Network.

The HV portion of system C is connected to the LV portion of the main system as follows:

C28 - BUS 82
C8 - BUS 83
C5 - BUS 85
C2 - BUS 89
C1 - BUS 92
C4 - BUS 95

4.1.5 IEEE 30 Bus Network D

The D subsystem has 6 true generator buses modeled as PV buses.

In an effort to achieve a more realistic overall network, some of the specified voltage magnitudes, VSPEC, and power generation data have been modified in conjuncton with the 250 Bus Network.

The HV portion of system D is connected to the LV portion of the main system as follows:

D1 - BUS 56
D4 - BUS 51
D5 - BUS 66
D8 - BUS 67
D28 - BUS 59

4.1.6 IEEE 14 Bus Network E

The E subsystem has five true generator buses modeled as PV buses.

In an effort to achieve a more realistic overall network, some of the specified voltage magnitudes, VSPEC, and power generation data have been modified in conjunction with the 250 Bus Network.

The HV portion of system E is connected to the LV portion of the main system as follows:

E1 - BUS 102
E2 - BUS 97
E5 - BUS 90

4.2. Updated Line Values

By inspection of the transmission line data extracted from the IEEE 118 Bus Test Network and from the IEEE 30 Bus Test Network, it is clear that some of the line charging values are set to rather "unusual" values. To correct for this, the following "algorithm" was used:

1. For each line compute the X/R ratio based on its reactance and resistance values as read from the original data files.

2. Based on the values of the X/R ratio and based on the EPRI data, contained in Appendix B, the length of the line is approximately determined.

3. Based on this length and the voltage level, determined from the X/R ratio, the computed value of wC is determined, wC comp.

4. If the data read from the original data files, wC, is such that:

$$0.334\ wC\ comp < wC < 1.66\ wC\ comp$$

Then the actual value of wC is retained as the wC set to be used for all future compensations.

If the value of wC is outside of the range mentioned above, then wC set is set to wC comp for all future computations.

This updating procedure is summarized in Appendix F where the values of wC set have an asterix attached to them when the value of wC has been set to wC comp.

4.3 Summary of Characteristic Dimensions.

The new 250 Bus System has:

a. 1 slack bus, BUS 69
79 PV buses of which 21 are strictly reactive power compensators
172 PQ buses simulating load buses
252 Buses

b. 365 transmission lines, modeled by their PI equivalent circuit

c. 28 transformers, with an off-nominal tap setting

d. 24 shunt admittance elements

417 total network elements, or branches

The resulting branch/node ratio is:

$$417/252 = 1.65$$

4.4. Base Cases

Three bases cases are defined as follows:

4.4.1. Base Case A

This base case is characterized as follows:

- The real power demands are set at 100% of their values specified by the IEEE data.

- The reactive power demands are set at 100% of their values specified by the IEEE data.

- The real power generations are set at their "low" values.

- Buses 40, 42, 90, 116 are consuming real power, i.e., they function as pumps.

The solution for Base Case A is given in Appendix G, including all Transmission Line data, all Transformer Data, and all Shunt Element Data. For all other Appendices relating to results for the 250 Bus System the line, transformer, and shunt element data will be ommitted and the reader is referred to Appendix G.

4.4.2. Base Case B

This base case is characterized as follows:

- The real power demands are set at 125% of their values specified by the IEEE data.

- The reactive power demands are set at 140% of their values specified by the IEEE data. This has the global effect of decreasing the system-wide power factor of the system which will have a negative impact on the system voltages.

- The real power generations have been increased at some PV buses to yield a set of "high" values.

- Buses 40, 42, 90, 116 are neither consuming or producing real power; they are running as spinning reserve.

The solution for Base Case B is given in Appendix H.

4.4.3. Bus Case C

This base case is characterized as follows:

- The real power demands are set at 130% of their values specified by the IEEE data.

- The reactive power demands are set at 140% of their values specified by the IEEE data (same as for base case A).

- The real power generations are set at their "high" values (same as for the base case B).

- Buses 40, 42, 90, 116 are now producing real power, i.e. they function as turbines.

The solution for Base Case C is given in Appendix I.

5. CYCLE TIME EVALUATION

The cycle time evaluation will be carried out on the basis of the following characteristic values for each load flow solution:

Time for compact, in CPU seconds
Time for factorization, in CPU seconds
No. of iterations and Time for solution, in CPU seconds

It should be noted that the two first times, i.e. the time required to compact the B' and B" matrices and the time required to factorize these two matrices will not change in a noticeable fashion from one solution to the other. However, the number of iterations and the time required to reach a solution will clearly depend on the severity of the particular case being simulated. The critical time is the solution time since the other two operations (compacting and factorizaton could be done in a background environment).

5.1. Contingencies Considered

In addition to the base case, or full system, the following four contingencies are considered:

5.1.1. Contingency I: Generation Curtailment

In this case, the following three generation plants have their generations curtailed:

BUS 10: 50% loss of real power generation
BUS 59: 100% loss of real power generation
BUS 80: 50% loss of real powe generation

This means that for Buses 10 and 80 half of the real power generation is lost while the generators remain as PV buses with the same respective reactive power generation limits. At Bus 59 all of the real power generation is lost, the generator remains connected to the network as spinning reserve with the same specified regulated voltage and the same reactive power limits.

For load case A, this corresponds to:

BUS 10: 225 MW lost
BUS 59: 155 MW lost
BUS 80: 223.5 MW lost
603.5 MW lost or 10.74% of the base case generation

For load Cases B and C, this corresponds to:

BUS 10: 285 MW lost
BUS 59: 155 MW lost
BUS 80 300 MW lost
740 MW lost

or 10.45% of the base case generation for load case B
or 10.04% of the base case generation for load case C

Clearly, Contingency I constitutes a rather severe loss of generation which will be felt throughout the system in view of the locations of the three generators affected.

5.1.2. Contingency II: Single Line Outage

For this contingency, the transmission line from BUS 25 to BUS 23 is removed.

By inspection of the base case solution for load case C, it is apparent that this line outage should have a rather significant impact on the system. For load case C, BUS 25 injects 220 MW and 88.44 MVAR net power into the network. BUS 25 is connected to three buses: BUS 23, BUS 27, BUS 26. But, the flow from BUS 25 to BUS 23 is equal to 229.6 +j65.0 MVA for the base case i.e. practically equal to the net injections at BUS 25. Therefore, the removal of the line from BUS 25 to BUS 23 should have a significant impact on the system.

5.1.3. Contingency III: Double Line Outage

For this contingency, the two transmission lines from BUS 89 to BUS 92 are removed.

Referring to the "high" generation case, BUS 89 is the largest generator in the entire system at 750 MW. BUS 89 is connected to five other buses as follows:

BUS 85, by one transmission line
BUS 88, by one transmission line
BUS 90, by two parallel, non-identical, transmission lines
BUS 92, by two parallel, non-identical, transmission lines
C2, by one transmission line.

Referring to base case C, the two lines from BUS 89 to BUS 92 collectively carry the heaviest flow (36.4% of the real power injection at BUS 89). Their removal should have a significant but moderate impact on the system in view of the other lines still available at BUS 89.

5.1.4. Contingency IV: Triple Line Outage

For this contingency, the two transmission lines from BUS 89 to BUS 92 and the transmission line from BUS 89 to BUS 88 are simultaneously removed.

Again, referring to base case C, the transmission corridor from BUS 88 to BUS 89 carries the second heaviest flow, after the BUS 88 to BUS 92 corridor. When both of these transmission routes are interrupted, the system impact should be very severe.

5.2. Cases Considered

Fifteen cases were simulated as follows:

Base Case A

Contingencies	AI
	AII
	AIII
	AIV

Base Case B

Contingencies	BI
	BII
	BIII
	BIV

Base Case C

Contingencies	CI
	CII
	CIII
	CIV

For each of the contingency simulations, a so-called "hot start" was used to better simulate a real time environment. This means that for each contingency, the corresponding base case voltage magnitude and phase angle solutions were used as initial approximations for the load (PQ) bus voltage magnitudes and phase angles for the contingency solutions. This means that for the contingency solutions, a flat voltage start was <u>not</u> used but rather the base case solution was used as the starting point. This was done for all A cases, then for all B cases, and finally for all C cases.

5.3. Results

5.3.1 A Cases

5.3.1.1. Base Case: Flat Voltage Start (Appendix: G)

Time for compact:	0.25 sec
Time for factorization:	0.30 sec
No. of iterations:	9.5
Time for solutions:	0.26 sec

This is not a particularly difficult case

Lowest voltage:	0.954 pu at BUS 109
Slack Bus injections:	194.15 MW and -35.71 MVAR
	Seven specified voltage levels exceeded
	Three specified voltage levels not maintained
System losses:	151.35 MW and -596.66 MVAR

5.3.1.2. Contingency AI: Hot start based on A (Appendix J)

Time for compact:	0.26 sec
Time for factorization:	0.30 sec
No. of iterations:	5
Time for solution:	0.23 sec

This is not a severe contingency

Lowest voltage:	0.954 pu at BUS 109
Slack Bus injections:	852.37 MW and -77.50 MVAR
	Seven specified voltage levels exceeded
	Four specified voltage levels not maintained
System losses:	176.07 MW and -507.99 MVAR

5.3.1.3. Contingency AII: Hot Start based on A (Appendix K)

Time for compact:	0.24 sec
Time for factorization:	0.29 sec
No. of iterations:	4.5
Time for solution:	0.20 sec

This is not a severe contingency

Lowest voltage:	0.954 pu at BUS 109
Slack Bus injections:	204.12 MW and -40.26 MVAR
	Seven specified voltage levels exceeded
	Three specified voltage levels not maintained
System losses:	161.32 MW and -514.49 MVAR

5.3.1.4. Contingency AIII: Hot Start based on A (Appendix L)

```
     Time for compact:  0.24 sec
Time for factorization:  0.29 sec
     No. of iterations:  7
     Time for solution:  0.28 sec

This is not a severe contingency

        Lowest voltage:  0.954 pu at BUS 109
  Slack Bus injections:  202.61 MW and -36.71 MVAR
                         Six specified voltage levels exceeded
                         Five specified voltage, levels not
                         maintained
         System losses:  159.81 MW and -556.47 MVAR
```

5.3.1.5. Contingency AIV: Hot start based on A (Appendix M)

```
     Time for compact:  0.23 sec
Time for factorization:  0.29 sec
     No. of iterations:  8
     Time for solution:  0.31 sec

This is still not a particularly severe contingency

        Lowest voltage:  0.954 pu at BUS 109
  Slack Bus injections:  210.58 MW and -38.16 MVAR
                         Six specified voltage levels exceeded
                         Six specified voltage levels not maintained
         System losses:  167.76 MW and -512.70 MVAR
```

5.3.2. B Cases

5.3.2.1. Base Case: Flat voltage start (Appendix H)

```
     Time for compact:  0.28 sec
Time for factorization:  0.33 sec
     No. of iterations:  34
    Time for solutions:  0.95 sec

This is already a rather severe base case

        Lowest voltage:  0.943 pu at BUS 109
  Slack Bus injections:  328 MW and -50.35 MVAR
                         Two specified voltage levels exceeded
                         24(!) specified voltage levels not
                         maintained
         System losses:  245.40 MW and -35.60 MVAR
```

5.3.2.2. Contingency BI: Hot start based on B (Appendix N)

```
     Time for compact:  0.24 sec
Time for factorization:  0.29 sec
     No. of iterations:  20
     Time for solution:  0.64 sec
```

This is a severe contingency with a general voltage drop throughout the entire system.

```
        Lowest voltage:  0.940 pu at BUS 38
  Slack Bus injections:  1131.31 MW and -65.41 MVAR
                         Two specified voltage levels exceeded
         System losses:  308.31 MW and +230.19 MVAR
```

5.3.2.3. Contingency BII: HOt start based on B (Appendix O)

```
     Time for compact:  0.26 sec
Time for factorization:  0.29 sec
     No. of iterations:  13
     Time for solution:  0.45 sec
```

This is a severe contingency with a general voltage drop through the system.

```
        Lowest voltage:  0.943 pu at BUS 109
  Slack Bus injections:  347.58 MW and -54.16 MVAR
                         Two specified voltage levels exceeded
                         27 (!) specified voltage levels not
                         maintained
         System losses:  264.58 MW and 94.38 MVAR
```

5.3.2.4. Contingency BIII: Hot start based on B (Appendix P)

```
     Time for compact:  0.25 sec
Time for factorization:  0.30 sec
     No. of iterations:  14
     Time for solution:  0.50 sec
```

Again, this is a rather severe contingency with a generalized system voltage drop.

```
        Lowest voltage:  0.943 pu at BUS 109
  Slack Bus injections:  343.91 MW and -52.12 MVAR
                         Two specified voltage levels exceeded
                         25 (!) specified voltage levels not
                         maintained
         System losses:  260.91 MW and 33.23 MVAR
```

5.3.2.5. Contingency BIV: Hot start based on B (Appendix Q)

```
     Time for compact:  0.24 sec
Time for factorization:  0.29 sec
     No. of iterations:  22
     Time for solution:  0.76 sec

This is the most severe of all B related contingencies.

        Lowest voltage:  0.928 pu at BUS 88
  Slack Bus injections:  359.99 MW and -54.73 MVAR
                         Two specified voltage levels exceeded
                         26 (!) specified voltage levels not
                         maintained
         System losses:  276.99 MW and 119.38 MVAR
```

5.3.3. C Cases

5.3.3.1. Base Case: Flat voltage start (Appendix I)

```
     Time for compact:  0.27 sec
Time for factorization:  0.32 sec
     No. of iterations:  38
     Time for solution:  1.08 sec

This is the most difficult base case solution

        Lowest voltage:  0.942 pu at BUS 109
  Slack Bus injections:  115.11 MW and -29.93 MVAR
                         Two specified voltage levels exceeded
                         29 (!) specified voltage levels not
                         maintained
         System losses:  258.67 MW and 31.67 MVAR
```

5.3.3.2. Contingency CI: Hot start based on C (Appendix R)

```
     Time for compact:  0.24 sec
Time for factorization:  0.30 sec
     No. of iterations:  22
     Time for solution:  0.76 sec

This is one of the most severe contingencies considered

        Lowest voltage:  0.942 pu at BUS 106
  Slack Bus injections:  915.06 MW and -74.36 MVAR
                         Two specified voltage levels exceeded
                         31 (!) specified voltage levels not
                         maintained
         System losses:  318.62 MW and 265.27 MVAR
```

5.3.3.3. Contingency CII: Hot start based on C (Appendix S)

```
     Time for compact:  0.23 sec
Time for factorization:  0.29 sec
     No. of iterations:  14
     Time for solution:  0.49
```

This is a severe case but not among the most severe ones considered in this study.

```
        Lowest voltage:  0.942 pu at BUS 109
  Slack Bus injections:  136.34 MW and -32.30 MVAR
                         Two specified voltage levels exceeded
         System losses:  279.90 MW and 171.13 MVAR
```

5.3.3.4. Contingency CIII: Hot start based on C (Appendix T)

```
     Time for compact:  0.24 sec
Time for factorization:  0.29 sec
     No. of iterations:  15
     Time for solution:  0.54 sec
```

This is a severe contingency but not among the most severe ones considered in this study.

```
        Lowest voltage:  0.942 pu at BUS 109
  Slack Bus injections:  134.27 MW and -37.98 MVAR
                         Two specified voltage levels exceeded
                         30 (!) specified voltage levels not
                         maintained
         System losses:  277.85 MW and 113.02 MVAR
```

5.3.3.5. Contingency CIV: Hot start based on C (Appendix U)

```
     Time for compact:  0.23 sec
Time for factorization:  0.28 sec
     No. of iterations:  26
     Time for solution:  0.80 sec
```

This is the most severe contingency considered

```
        Lowest voltage:  0.918 pu at BUS 88
  Slack Bus injections:  153.54 MW and -36.13 MVAR
                         Two specified voltage levels exceeded
                         32 (!) specified voltage levels not
                         maintained
         System losses:  297.10 MW and 215.08 MVAR
```

5.4. Summary of Results:

- As expected, the "time for compact" and "time for factorization" did not vary much form one solution to the other. Indeed, each case was executed as a separate simulation. The only discrepancies of these times indicate the relative load of the time sharing system used to carry out these simulations.

  The average time for compact was: 0.2457 sec.
  The shortest time was 0.23 sec, the longest time was 0.28 sec.

  The average time for factorization was 0.2967 sec.
  The shortest time was 0.28 sec, the longest time was 0.33 sec.

  It should be noticed that both of these operations can be done in a background environment before the actual solution actually starts. The average required time would be 0.5433 sec.

- For the three base case solutions 9.5, 34, respectively 38 interations were required basically due to the large voltage excursions reached with respect to the initial flat voltage start used.

  The shortest time for a base case solution was 0.26 sec for case A; the longest time for solution was 1.08 sec for case C.

- For the 12 contingency cases run, the smallest number of iterations required was 4.5 (AII) while the largest was 26 (CIV). The corresponding shortest time for solution was 0.20 sec while the longest time for solution was 0.80 sec.

- The average time per iteration was 0.0351 sec. The longest time per iteration was 0.0460 sec while the shortest time per iteration was 0.0274 sec.

- As is clearly evidenced by these results, the fast decoupled load flow technique solution time is heavily dependent on:

  - how good the initial assumption for the PQ bus voltages are (use hot start).

  - how many PV buses actually hit their respective reactive power limits during the solution procedure.

  - how big the imbalance is between the set power generation and set power demands, i.e. what the slack bus contribution ends up being.

  - other factors are discussed in the next section.

5.5. Two Other Considerations

5.5.1. Precision Used

For all previous cases, A, AI-AIV, B, BI-BIV, C, CI-CIV, the maximum real power and reactive power mismatch tolerated at any bus at the converged solution was limited to 10^{-3} pu.

Clearly, if this constraint is relaxed, one should expect a more rapid convergence. This was verified by running the base case for case C again with the maximum mismatch tolerated set at 10^{-2} pu instead of the 10^{-3} previously used. As a result, the convergence was obtained in 20 iterations instead of the previous 38 required for a 10^{-3} pu constraint. As can be seen by inspection of Appendix V, the results have not suffered noticeably by this change in convergence criterion.

5.5.2 X/R ratio

It is well known that the Fast Decoupled Load Flow is based on the assumption that the transversal resistance of the transmission elements are very much smaller than their transversal reactance. For the original 250 Bus System, the highest X/R ratio is no larger than 12.5 while the lowest is below 2; not a very favorable situation for the Fast Decoupled Load Flow.

To test for this influence, the program was modified to read in a coefficient, r, such that all subsequent transmission line resistances be multiplied by r. The base case C was then rerun for various values of r, with the following results:

r=1	No. of iterations 38
0.8	34
0.7	32
0.6	25
0.5	23
0.4	21
0.3	21
0.2	21
0.1	20
0.05	20
0.01	20

The influence of the X/R is clearly demonstrated here.

5.5.3. Combined effect

Finally, the base case C was rerun with an r coefficient set at 0.5 and with a mismatch tolerance set at 10^{-2}. For this case only 12 iterations were required to reach a solution as opposed to 23 when the tolerance is at 10^{-3} for r = 0.5, and as opposed to 38 iterations when the tolerance is at 10^{-3} and r = 1.

6. BENCH MARK PROGRAMS

In an effort to be able to compare the computational speed of Georgia Tech's CDC CYBER 180/855 computer, used for the simulation of this study, with that of other computers, two Bench Mark programs are included in Appendix W.

6.1. Program Bench 1

This program computes the sum of all numbers from 1 to 10000 and also the sum of the squares of the same numbers. The process is repeated 20 times to mask away the overhead time required for the timing routines themselves.

The program, as listed, executed in 0.971 sec while using the same compiler (and options) as used for the load program used for the study.

6.2. Program Bench 2

This program computes prime numbers, and is a very well recognized test program to evaluate computational speeds of various computers.

Two versions of the program are given in Appendix W:

- One version which prints the actual prime numbers to verify the proper operation of the code itself. The correspondng output is also provided.

- Another version where the prime numbers detected are no longer printed (to avoid the printing overhead which is heavily computer and load dependent) and where the range is extended to all numbers from 1 to 8191. Finally, the process is repeated 10 times, again to mask out the overhead associated with the timing routines themselves. The required CPU time was 0.339 sec.

7. CONCLUSION

Based on a Fast Decoupled Load Flow program, the computational cycle times for steady state power flow calculations have been evaluated in the present report. The evaluations are based on a 250 Bus Network specially built for the purposes of this project, and which is purely fictitious.

The computational times are based on a CDC CYBER 180/855 Computer using the maximum optimization level of the available Fortran compiler. It should be noticed that this machine is running under heavy use under timesharing. As a result, the stated computational times are certainly high estimates which could be reduced by programming major portions of the program in "machine code" and by running the code on a dedicated "real time" computer.

Appendix A

IEEE 30 Bus Network

A.1. Transmission line data
Transformer data
Shunt element data

A.2. Bus oriented results

A.3. Line flow results

Sbase: 100.

Transmission Lines

NO	NE	R %	X %	X/R	wC*Sbase	Length
Bus 1	Bus 2	1.920	5.750	2.99	2.640	29.3
Bus 1	Bus 3	4.520	18.520	4.10	2.040	78.7
Bus 2	Bus 4	5.700	17.370	3.05	1.840	87.6
Bus 3	Bus 4	1.320	3.790	2.87	.420	19.8
Bus 2	Bus 5	4.720	19.830	4.20	2.090	83.1
Bus 2	Bus 6	5.810	17.630	3.03	1.870	89.2
Bus 4	Bus 6	1.190	4.140	3.48	.450	19.3
Bus 5	Bus 7	4.600	11.600	2.52	1.020	66.0
Bus 6	Bus 7	2.670	8.200	3.07	.850	41.2
Bus 6	Bus 8	1.200	4.200	3.50	.450	19.5
Bus 9	Bus 11	.000	20.800			
Bus 9	Bus 10	.000	11.000			
Bus 12	Bus 13	.000	14.000			
Bus 12	Bus 14	12.310	25.590	2.08		16.1
Bus 12	Bus 15	6.620	13.040	1.97		8.4
Bus 12	Bus 16	9.450	19.870	2.10		12.4
Bus 14	Bus 15	22.100	19.970	.90		20.5
Bus 16	Bus 17	8.240	19.320	2.34		11.5
Bus 15	Bus 18	10.700	21.850	2.04		13.8
Bus 18	Bus 19	6.390	12.920	2.02		8.2
Bus 19	Bus 20	3.400	6.800	2.00		4.4
Bus 10	Bus 20	9.360	20.900	2.23		12.7
Bus 10	Bus 17	3.240	8.450	2.61		47.0
Bus 10	Bus 21	3.480	7.490	2.15		4.6
Bus 10	Bus 22	7.270	14.990	2.06		9.4
Bus 21	Bus 22	1.160	2.360	2.03		1.5
Bus 15	Bus 23	10.000	20.200	2.02		12.9
Bus 22	Bus 24	11.500	17.900	1.56		13.1
Bus 23	Bus 24	13.200	27.000	2.05		17.1
Bus 24	Bus 25	18.850	32.920	1.75		22.6
Bus 25	Bus 26	25.440	38.000	1.49		28.4
Bus 25	Bus 27	10.930	20.870	1.91		13.7
Bus 27	Bus 29	21.980	41.530	1.89		27.4
Bus 27	Bus 30	32.020	60.270	1.88		39.8
Bus 29	Bus 30	23.990	45.330	1.89		29.9
Bus 8	Bus 28	6.360	20.000	3.14	2.140	99.0
Bus 6	Bus 28	1.690	5.990	3.54	.650	27.6

Transformers

NO	NE	R %	X %	Tap
Bus 6	Bus 9	.000	20.800	.978
Bus 6	Bus 10	.000	55.600	.969
Bus 4	Bus 12	.000	25.600	.932
Bus 28	Bus 27	.000	39.600	.968

Shunt Elements

NO	wC*Sbase
Bus 10	19.011
Bus 24	4.000

```
   Time for input:    .16
   Time for compact:    .01
   Time for factorization:    .01
o. of iterations:  4.5
aximum mismatch (in pu):  1.1E-05 8.2E-05
   Time for solution:    .01
xecution time:    .19

 base : 100.
```

Bus	Vsp	Voltage		Generation		QGmin	QGmax	Load	
ıs 1		1.050	.00	98.79	-3.13				
ıs 2	1.045	1.045	-1.85	80.00	47.66	-20.00	60.00	21.70	12.70
ıs 5	1.010	1.010	-6.51	50.00	19.16	-15.00	62.45	94.20	19.00
ıs 8	1.010	1.010	-5.65	20.00	33.75	-15.00	56.57	30.00	30.00
ıs 11	1.050	1.050	-4.56	20.00	7.01	-10.00	45.83	.00	.00
ıs 13	1.050	1.050	-6.32	20.00	3.79	-15.00	56.57	.00	.00

Bus	Voltage		Load	
us 3	1.019	-3.77	2.40	1.20
us 4	1.012	-4.51	7.60	1.60
us 6	1.010	-5.34	.00	.00
us 7	1.002	-6.35	22.80	10.90
us 9	1.037	-6.75	.00	.00
us 10	1.033	-8.67	5.80	2.00
us 12	1.045	-7.78	11.20	7.50
us 14	1.030	-8.72	6.20	1.60
us 15	1.026	-8.85	8.20	2.50
us 16	1.033	-8.44	3.50	1.80
us 17	1.028	-8.82	9.00	5.80
s 18	1.016	-9.50	3.20	.90
s 19	1.014	-9.69	9.50	3.40
s 20	1.018	-9.49	2.20	.70
s 21	1.021	-9.15	17.50	11.20
s 22	1.021	-9.15	.00	.00
s 23	1.015	-9.34	3.20	1.60
s 24	1.010	-9.65	8.70	6.70
s 25	1.008	-9.65	.00	.00
s 26	.990	-10.08	3.50	2.30
s 27	1.016	-9.38	.00	.00
s 28	1.005	-5.81	.00	.00
s 29	.996	-10.63	2.40	.90
s 30	.984	-11.53	10.60	1.90

er Generated:	288.79	108.25
er Demanded:	283.40	126.20
tem Losses:	5.39	-17.95

ntout time: .15

Bus 1	Bus 2	58.61	-10.90
Bus 1	Bus 3	40.18	7.77
	Total:	98.79	-3.13

Bus 2	Bus 1	-58.00	9.84
Bus 2	Bus 4	31.47	9.03
Bus 2	Bus 5	45.46	8.24
Bus 2	Bus 6	39.36	7.85
	Total:	58.30	34.96

Bus 5	Bus 2	-44.53	-6.54
Bus 5	Bus 7	.33	6.69
	Total:	-44.20	.16

Bus 8	Bus 6	-11.94	3.17
Bus 8	Bus 28	1.94	.58
	Total:	-10.00	3.75

Bus 11	Bus 9	20.00	7.01
	Total:	20.00	7.01

Bus 13	Bus 12	20.00	3.79
	Total:	20.00	3.79

Bus 3	Bus 1	-39.48	-7.11
Bus 3	Bus 4	37.08	5.91
	Total:	-2.40	-1.20

Bus 4	Bus 2	-30.90	-9.24
Bus 4	Bus 3	-36.90	-5.82
Bus 4	Bus 6	34.85	-4.57
Bus 4	Bus 12	25.36	18.03
	Total:	-7.60	-1.60

Bus 6	Bus 2	-38.50	-7.20
Bus 6	Bus 4	-34.71	4.60
Bus 6	Bus 7	22.63	2.79
Bus 6	Bus 8	11.96	-3.57
Bus 6	Bus 28	14.72	3.23
Bus 6	Bus 9	12.65	-1.89
Bus 6	Bus 10	11.25	2.03
	Total:	.00	.00

7	Bus 5	-.30	-7.67
7	Bus 6	-22.50	-3.23
	Total:	-22.80	-10.90

9	Bus 11	-20.00	-6.17
9	Bus 10	32.65	3.96
9	Bus 6	-12.65	2.21
	Total:	.00	.00

10	Bus 9	-32.65	-2.85
10	Bus 20	8.89	3.78
10	Bus 17	4.98	4.84
10	Bus 21	16.28	9.58
.0	Bus 22	7.94	4.31
:0	Bus 6	-11.25	-1.36
.0	Bus 10	.00	-20.30
	Total:	-5.80	-2.00

.2	Bus 13	-20.00	-3.26
.2	Bus 14	8.01	2.29
.2	Bus 15	18.54	6.45
.2	Bus 16	7.61	2.95
.2	Bus 4	-25.36	-15.93
	Total:	-11.20	-7.50

4	Bus 12	-7.93	-2.13
4	Bus 15	1.73	.53
	Total:	-6.20	-1.60

5	Bus 12	-18.31	-5.99
5	Bus 14	-1.72	-.52
5	Bus 18	6.16	1.54
5	Bus 23	5.67	2.48
	Total:	-8.20	-2.50

6	Bus 12	-7.55	-2.83
6	Bus 17	4.05	1.03
	Total:	-3.50	-1.80

7	Bus 16	-4.04	-1.00
7	Bus 10	-4.96	-4.80
	Total:	-9.00	-5.80

Bus 18	Bus 15	-6.11	-1.45
Bus 18	Bus 19	2.91	.55
	Total:	-3.20	-.90
Bus 19	Bus 18	-2.91	-.54
Bus 19	Bus 20	-6.59	-2.86
	Total:	-9.50	-3.40
Bus 20	Bus 19	6.61	2.89
Bus 20	Bus 10	-8.81	-3.59
	Total:	-2.20	-.70
Bus 21	Bus 10	-16.17	-9.33
Bus 21	Bus 22	-1.33	-1.87
	Total:	-17.50	-11.20
Bus 22	Bus 10	-7.89	-4.20
Bus 22	Bus 21	1.33	1.87
Bus 22	Bus 24	6.55	2.33
	Total:	.00	.00
Bus 23	Bus 15	-5.64	-2.40
Bus 23	Bus 24	2.44	.80
	Total:	-3.20	-1.60
Bus 24	Bus 22	-6.50	-2.24
Bus 24	Bus 23	-2.43	-.78
Bus 24	Bus 25	.23	.41
Bus 24	Bus 24	.00	-4.08
	Total:	-8.70	-6.70
?us 25	Bus 24	-.23	-.41
?us 25	Bus 26	3.55	2.37
?us 25	Bus 27	-3.32	-1.96
	Total:	.00	.00
us 26	Bus 25	-3.50	-2.30
	Total:	-3.50	-2.30
?s 27	Bus 25	3.33	1.99
?s 27	Bus 29	6.19	1.67

s	27	Bus 30	7.09	1.67
s	27	Bus 28	-16.62	-5.33
	Total:		.00	.00

s	28	Bus 8	-1.94	-2.74
s	28	Bus 6	-14.68	-3.76
s	28	Bus 27	16.62	6.50
	Total:		.00	.00

	29	Bus 27	-6.10	-1.51
	29	Bus 30	3.70	.61
	Total:		-2.40	-.90

	30	Bus 27	-6.93	-1.36
	30	Bus 29	-3.67	-.54
	Total:		-10.60	-1.90

em losses:	5.39	-17.95

Appendix B

EPRI Based

Typical Transmission Line Data

Using the EPRI report on

"Synthetic Electric Utility Systems for Evaluating Advanced Technologies"

EPRI EM-285
Project TPS-75-615
February 1977, Final Report

the following data is extracted:

Line KV	R X %/mile	X/R %/mile	Admittance	%/mile
33	1.25	2.5	X/R < 2.5	0.004
115-161	0.0845	0.413	2.5 < X/R < 5.5	0.104
230	0.0245	0.152	5.5 < X/R < 8	0.285
345	0.00468	0.050	8 < X/R < 14	0.858
500 and up	0.00126	0.0245	X/R > 14	1.74

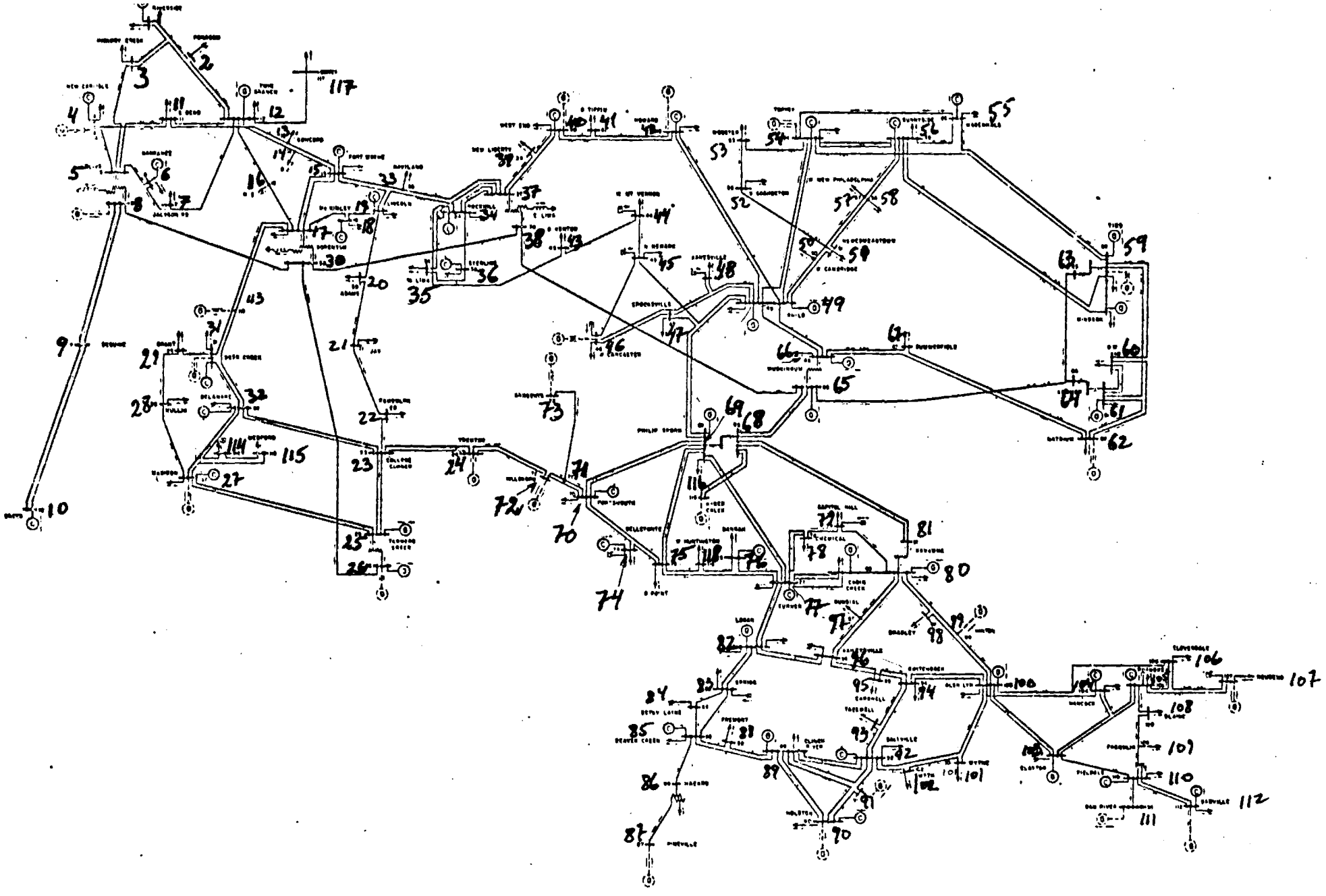
Appendix C

IEEE (AEP) 118 Bus Network

Raw Data

AEP 118 BUS TEST SYSTEM

The data for this system, part of American Electric Power, is being made available to the electric utility industry as a standard test case for evaluating various analytical methods and computer programs for the solution of power networks. If further information is desired, please contact Mr. Glenn W. Stagg, American Electric Power Service Corporation, 2 Broadway, New York 8, New York, HAnover 2-4800, Ext. 640.



AEP 118 BUS TEST SYSTEM BUS CODE DIAGRAM

AEP 118 BUS TEST SYSTEM

OPERATING CONDITIONS

Bus Number	Starting Bus Voltage Magnitude Per Unit	Starting Bus Voltage Phase Angle Degrees	Generation Mw	Generation Mvar	Load Mw	Load Mvar
1	1.0	0	0	0	51	27
2	1.0	0	0	0	20	9
3	1.0	0	0	0	39	10
4	1.0	0	-9	0	30	12
5	1.0	0	0	0	0	0
6	1.0	0	0	0	52	22
7	1.0	0	0	0	19	2
8	1.0	0	-28	0	0	0
9	1.0	0	0	0	0	0
10	1.0	0	450	0	0	0
11	1.0	0	0	0	70	23
12	1.0	0	85	0	47	10
13	1.0	0	0	0	34	16
14	1.0	0	0	0	14	1
15	1.0	0	0	0	90	30
16	1.0	0	0	0	25	10
17	1.0	0	0	0	11	3
18	1.0	0	0	0	60	34
19	1.0	0	0	0	45	25
20	1.0	0	0	0	18	3
21	1.0	0	0	0	14	8
22	1.0	0	0	0	10	5
23	1.0	0	0	0	7	3
24	1.0	0	-13	0	0	0
25	1.0	0	220	0	0	0
26	1.0	0	314	0	0	0
27	1.0	0	-9	0	62	13
28	1.0	0	0	0	17	7
29	1.0	0	0	0	24	4
30	1.0	0	0	0	0	0
31	1.0	0	7	0	43	27
32	1.0	0	0	0	59	23
33	1.0	0	0	0	23	9
34	1.0	0	0	0	59	26
35	1.0	0	0	0	33	9
36	1.0	0	0	0	31	17
37	1.0	0	0	0	0	0
38	1.0	0	0	0	0	0
39	1.0	0	0	0	27	11
40	1.0	0	-46	0	20	23
41	1.0	0	0	0	37	10
42	1.0	0	-59	0	37	23
43	1.0	0	0	0	18	7
44	1.0	0	0	0	16	8
45	1.0	0	0	0	53	22
46	1.0	0	19	0	28	10
47	1.0	0	0	0	34	0

AEP 118 BUST TEST SYSTEM
OPERATING CONDITIONS Contd.

Bus Number	Starting Bus Voltage Magnitude Per Unit	Starting Bus Voltage Phase Angle Degrees	Generation Mw	Generation Mvar	Load Mw	Load Mvar
48	1.0	0	0	0	20	11
49	1.0	0	204	0	87	30
50	1.0	0	0	0	17	4
51	1.0	0	0	0	17	8
52	1.0	0	0	0	18	5
53	1.0	0	0	0	23	11
54	1.0	0	48	0	113	32
55	1.0	0	0	0	63	22
56	1.0	0	0	0	84	18
57	1.0	0	0	0	12	3
58	1.0	0	0	0	12	3
59	1.0	0	155	0	277	113
60	1.0	0	0	0	78	3
61	1.0	0	160	0	0	0
62	1.0	0	0	0	77	14
63	1.0	0	0	0	0	0
64	1.0	0	0	0	0	0
65	1.0	0	391	0	0	0
66	1.0	0	392	0	39	18
67	1.0	0	0	0	28	7
68	1.0	0	0	0	0	0
69 *	1.035	30	516.4	0	0	0
70	1.0	0	0	0	66	20
71	1.0	0	0	0	0	0
72	1.0	0	-12	0	0	0
73	1.0	0	-6	0	0	0
74	1.0	0	0	0	68	27
75	1.0	0	0	0	47	11
76	1.0	0	0	0	68	36
77	1.0	0	0	0	61	28
78	1.0	0	0	0	71	26
79	1.0	0	0	0	39	32
80	1.0	0	477	0	130	26
81	1.0	0	0	0	0	0
82	1.0	0	0	0	54	27
83	1.0	0	0	0	20	10
84	1.0	0	0	0	11	7
85	1.0	0	0	0	24	15
86	1.0	0	0	0	21	10
87	1.0	0	4	0	0	0
88	1.0	0	0	0	48	10
89	1.0	0	607	0	0	0
90	1.0	0	-85	0	78	42
91	1.0	0	-10	0	0	0
92	1.0	0	0	0	65	10
93	1.0	0	0	0	12	7
94	1.0	0	0	0	30	16
95	1.0	0	0	0	42	31
96	1.0	0	0	0	38	15
97	1.0	0	0	0	15	9
98	1.0	0	0	0	34	8

* Swing machine

AEP 118 BUS TEST SYSTEM
CPERATING CONDITIONS Contd.

Bus Number	Starting Bus Voltage Magnitude Per Unit	Starting Bus Voltage Phase Angle Degrees	Generation Mw	Generation Mvar	Load Mw	Load Mvar
99	1.0	0	-42	0	0	0
100	1.0	0	252	0	37	18
101	1.0	0	0	0	22	15
102	1.0	0	0	0	5	3
103	1.0	0	40	0	23	16
104	1.0	0	0	0	38	25
105	1.0	0	0	0	31	26
106	1.0	0	0	0	43	16
107	1.0	0	-22	0	28	12
108	1.0	0	0	0	2	1
109	1.0	0	0	0	8	3
110	1.0	0	0	0	39	30
111	1.0	0	36	0	0	0
112	1.0	0	-43	0	25	13
113	1.0	0	-6	0	0	0
114	1.0	0	0	0	8	3
115	1.0	0	0	0	22	7
116	1.0	0	-184	0	0	0
117	1.0	0	0	0	20	8
118	1.0	0	0	0	33	15

AEP 118 BUS TEST SYSTEM *
IMPEDANCE AND LINE CHARGING DATA

Line Designation	Resistance Per Unit**	Reactance Per Unit**	Line Charging Per Unit**
1 - 2	.03030	.09990	.01270
1 - 3	.01290	.04240	.00541
4 - 5	.00176	.00798	.00105
3 - 5	.02410	.10800	.01420
5 - 6	.01190	.05400	.00713
6 - 7	.00459	.02080	.00275
8 - 9	.00244	.03050	.58100
5 - 8	0	.02670	0
9 - 10	.00258	.03220	.61500
4 - 11	.02090	.06880	.00874
5 - 11	.02030	.06820	.00869
11- 12	.00595	.01960	.00251
2 - 12	.01870	.06160	.00786
3 - 12	.04840	.16000	.02030
7 - 12	.00862	.03400	.00437
11- 13	.02225	.07310	.00938
12- 14	.02150	.07070	.00908
13- 15	.07440	.24440	.03134
14- 15	.05950	.19500	.02510
12- 16	.02120	.08340	.01070
15- 17	.01320	.04370	.02220
16- 17	.04540	.18010	.02330
17- 18	.01230	.05050	.00649
18- 19	.01119	.04930	.00571
19- 20	.02520	.11700	.01490
15- 19	.01200	.03940	.00505
20- 21	.01830	.08490	.01080
21- 22	.02090	.09700	.01230
22- 23	.03420	.15900	.02020
23- 24	.01350	.04920	.02490
23- 25	.01560	.08000	.04320
25- 26	0	.03820	0
25- 27	.03180	.16300	.08820
27- 28	.01913	.08550	.01080
28- 29	.02370	.09430	.01190
17- 30	0	.03880	0
8 - 30	.00431	.05040	.25700
26- 30	.00799	.08600	.45400
17- 31	.04740	.15630	.01995
29- 31	.01080	.03310	.00415
23- 32	.03170	.11530	.05865
31- 32	.02980	.09850	.01255
27- 32	.02290	.07550	.00963
15- 33	.03800	.12440	.01597
19- 34	.07520	.24700	.03160
35- 36	.00224	.01020	.00134
35- 37	.01100	.04970	.00659
33- 37	.04150	.14200	.01830
34- 36	.00871	.02680	.00284

AEP 118 BUS TEST SYSTEM
IMPEDANCE AND LINE CHARGING DATA Contd.

Line Designation	Resistance Per Unit**	Reactance Per Unit**	Line Charging Per Unit**
34- 37	.00256	.00940	.00492
37- 38	0	.03750	[illegible]
37- 39	.03210	.10600	.01350
37- 40	.05930	.16800	.02100
30- 38	.00464	.05400	.21100
39- 40	.01840	.06050	.00776
40- 41	.01450	.04870	.00611
40- 42	.05550	.18300	.02330
41- 42	.04100	.13500	.01720
43- 44	.06080	.24540	.03034
34- 43	.04130	.16810	.02113
44- 45	.02240	.09010	.01120
45- 46	.04000	.13560	.01660
46- 47	.03800	.12700	.01580
46- 48	.06010	.18900	.02360
47- 49	.01910	.06250	.00802
42- 49	.07150	.32300	.04300
42- 49	.07150	.32300	.04300
45- 49	.06840	.18600	.02220
48- 49	.01790	.05050	.00629
49- 50	.02670	.07520	.00937
49- 51	.04860	.13700	.01710
51- 52	.02030	.05880	.00698
52- 53	.04050	.16350	.02029
53- 54	.02630	.12200	.01550
49- 54	.07300	.28900	.03690
49- 54	.08690	.29100	.03650
54- 55	.01690	.07070	.01010
54- 56	.00275	.00955	.00366
55- 56	.00488	.01510	.00187
56- 57	.03430	.09660	.01210
50- 57	.04740	.13400	.01660
56- 58	.03430	.09660	.01210
51- 58	.02550	.07190	.00894
54- 59	.05030	.22930	.02990
56- 59	.08250	.25100	.02845
56- 59	.08030	.23900	.02680
55- 59	.04739	.21580	.02823
59- 60	.03170	.14500	.01880
59- 61	.03280	.15000	.01940
60- 61	.00264	.01350	.00728
60- 62	.01230	.05610	.00731
61- 62	.00824	.03760	.00490
59- 63	0	.03860	0
63- 64	.00172	.02000	.10800
61- 64	0	.02680	0
38- 65	.00901	.09860	.52300
64- 65	.00269	.03020	.19000
49- 66	.01800	.09190	.01240
49- 66	.01800	.09190	.01240
62- 66	.04820	.21800	.02890
62- 67	.02580	.11700	.01550

AEP 118 BUS TEST SYSTEM
IMPEDANCE AND LINE CHARGING DATA Contd.

Line Designation	Resistance Per Unit **	Reactance Per Unit**	Line Charging Per Unit**
65- 66	0	.03700	0
66- 67	.02240	.10150	.01341
65- 68	.00138	.01600	.31900
47- 69	.08440	.27780	.03546
49- 69	.09850	.32400	.04140
68- 69	0	.03700	0
69- 70	.03000	.12700	.06100
24- 70	.10221	.41150	.05099
70- 71	.00882	.03550	.00439
24- 72	.04880	.19600	.02440
71- 72	.04460	.18000	.02222
71- 73	.00866	.04540	.00589
70- 74	.04010	.13230	.01684
70- 75	.04280	.14100	.01800
69- 75	.04050	.12200	.06200
74- 75	.01230	.04060	.00517
76- 77	.04440	.14800	.01840
69- 77	.03090	.10100	.05190
75- 77	.06010	.19990	.02489
77- 78	.00376	.01240	.00632
78- 79	.00546	.02440	.00324
77- 80	.01700	.04850	.02360
77- 80	.02940	.10500	.01140
79- 80	.01560	.07040	.00935
68- 81	.00175	.02020	.40400
80- 81	0	.03700	0
77- 82	.02980	.08530	.04087
82- 83	.01120	.03665	.01898
83- 84	.06250	.13200	.01290
83- 85	.04300	.14800	.01740
84- 85	.03020	.06410	.00617
85- 86	.03500	.12300	.01380
86- 87	.02828	.20740	.02225
85- 88	.02000	.10200	.01380
85- 89	.02390	.17300	.02350
88- 89	.01390	.07120	.00967
89- 90	.05180	.18800	.02640
89- 90	.02380	.09970	.05300
90- 91	.02540	.08360	.01070
89- 92	.00990	.05050	.02740
89- 92	.03930	.15810	.02070
91- 92	.03870	.12720	.01634
92- 93	.02580	.08480	.01090
92- 94	.04810	.15800	.02030
93- 94	.02230	.07320	.00938
94- 95	.01320	.04340	.00555
80- 96	.03560	.18200	.02470

AEP 118 BUS TEST SYSTEM
IMPEDANCE AND LINE CHARGING DATA Contd.

Line Designation	Resistance Per Unit**	Reactance Per Unit**	Line Charging Per Unit**
82- 96	.01620	.05300	.02720
94- 96	.02690	.08690	.01150
80- 97	.01830	.09340	.01270
80- 98	.02380	.10800	.01430
80- 99	.04540	.20600	.02730
92- 100	.06480	.29500	.03860
94- 100	.01780	.05800	.03020
95- 96	.01710	.05470	.00737
96- 97	.01730	.08850	.01200
98- 100	.03970	.17900	.02380
99- 100	.01800	.08130	.01080
100- 101	.02770	.12620	.01640
92- 102	.01230	.05590	.00732
101- 102	.02460	.11200	.01470
100- 103	.01600	.05250	.02680
100- 104	.04510	.20400	.02705
103- 104	.04660	.15840	.02035
103- 105	.05350	.16250	.02040
100- 106	.06050	.22900	.03100
104- 105	.00994	.03780	.00493
105- 106	.01400	.05470	.00717
105- 107	.05300	.18300	.02360
105- 108	.02610	.07030	.00922
106- 107	.05300	.18300	.02360
108- 109	.01050	.02880	.00380
103- 110	.03906	.18130	.02305
109- 110	.02780	.07620	.01010
110- 111	.02200	.07550	.01000
110- 112	.02470	.06400	.03100
17- 113	.00913	.03010	.00384
32- 113	.06150	.20300	.02590
32- 114	.01350	.06120	.00814
27- 115	.01640	.07410	.00986
114- 115	.00230	.01040	.00138
68- 116	.00034	.00405	.08200
12- 117	.03290	.14000	.01790
75- 118	.01450	.01810	.00599
76- 118	.01640	.05440	.00678

* Based on AEP System for Total Loss Formula June 1962

** Impedance and line-charging susceptance in per unit on a 100,000 kva base

Line charging one-half of total charging of line

CH

AEP 118 BUS TEST SYSTEM

REGULATED BUS DATA 53

Bus Number	Voltage Magnitude Per Unit	Minimum Mvar Capability	Maximum Mvar Capability
1	.955	-5	15
4	.998	-300	300
6	.99	-13	50
8	1.015	-300	300
10	1.05	-147	200
12	.99	-35	120
15	.97	-10	30
18	.973	-16	50
19	.962	-8	24
24	.992	-300	300
25	1.05	-47	140
26	1.015	-1000	1000
27	.968	-300	300
31	.967	-300	300
32	.963	-14	42
34	.984	-8	24
36	.98	-8	24
40	.97	-300	300
42	.985	-300	300
46	1.005	-100	100
49	1.025	-85	210
54	.955	-300	300
55	.952	-8	23
56	.954	-8	15
59	.985	-60	180
61	.995	-100	300
62	.998	-20	20
65	1.005	-67	200
66	1.05	-67	200
70	.984	-10	32
72	.98	-100	100
73	.991	-100	100
74	.958	-6	9
76	.943	-8	23
77	1.006	-20	70
80	1.04	-165	280
85	.985	-8	23
87	1.015	-100	1000
89	1.005	-210	300
90	.985	-300	300
91	.98	-100	100
92	.99	-3	9
99	1.01	-100	100

AEP 118 BUS TEST SYSTEM
REGULATED BUS DATA Contd.

Bus Number	Voltage Magnitude Per Unit	Minimum Mvar Capability	Maximum Mvar Capability
100	1.017	-50	155
103	1.01	-15	40
104	.971	-8	23
105	.965	-8	23
107	.952	-200	200
110	.973	-8	23
111	.98	-100	1000
112	.975	-100	1000
113	.993	-100	200
116	1.005	-1000	1000

AEP 118 BUS TEST SYSTEM
TRANSFORMER DATA

Transformer Designation	Tap Setting*
8-5	.985
26-25	.96
30-17	.96
38-37	.935
63-59	.96
64-61	.985
65-66	.935
68-69	.935
81-80	.935

* Off-nominal turns ratio, as determined by the actual transformer tap positions and the voltage bases. In the case of nominal turns ratio, this would equal 1.

AEP 113 BUS TEST SYSTE'
STATIC CAPACITOR DATA

Bus Number	Susceptance Per Unit*
5	-.4
17	0
34	.14
37	-.25
44	.1
45	.1
46	.1
48	.15
74	.12
79	.2
82	.2
83	.1
105	.2
107	.06
110	.06

* Susceptance in per unit on a 100,000-kva base

AEP 118 BUS TEST SYSTEM
LOAD FLOW SOLUTION

The results of the test load flow are listed in the following pages. Data pertinent to each bus of the system is listed with the corresponding bus number which, in turn, refers to the original bus coding diagram. Printed from left to right following each bus number, and in this order, is bus voltage in per unit, phase angle in degrees, system generation in megawatts and megavars, and bus load in megawatts and megavars. Where static capacitors or shunt reactors are connected to the bus, their contribution in megavars is also specified (plus for capacitors, minus for reactors).

Power and reactive flows in and out of each bus are tabulated under that bus number and are designated by the bus numbers at the far ends of the circuits. Plus values indicate flow of power and reactive out of a bus, and minus values indicate flow into a bus. Tap settings are printed next to those flows which represent transformer loadings. The tap is listed only once and for that bus on which the tap is represented.

The location of the swing machine, megawatt and megavar losses and the mismatch are printed following the information pertaining to the last bus. The mismatch in megawatts and megavars is listed next for each bus of the system in order of the bus numbers. It is the net difference in the flow of power or reactive in and out of a particular bus and is a test of the accuracy of the results. The final figures, following the mismatch, are the number of iterations, and the total and average mismatch excluding the swing machine. The large mismatch value for the swing bus results from not estimating the value of its generation.

Following the load flow output is a listing of the original line and transformer impedance data followed by an ordered double entry list of line and transformer admittances.

AEP 118 BUS TEST SYSTEM
CASE 1 1962 LOADS

BASE CASE

BUS	1	.955	10.67	.0	-3.0	51.00	27.00	
	2	-12.5	-13.0					
	3	-38.8	-17.0					
BUS	2	.971	11.22	.0	.0	20.00	9.00	
	1	12.6	11.0					
	12	-32.6	-19.9					
BUS	3	.968	11.56	.0	.0	39.00	10.00	
	1	39.1	16.8					
	5	-68.2	-14.5					
	12	-9.9	-12.4					
BUS	4	.998	15.28	-9.0	-14.8	30.00	12.00	
	5	-104.4	-26.6					
	11	64.1	-.2					
BUS	5	1.002	15.73	.0	.0	.00	.00	-40.16
	3	69.4	17.3					
	4	104.6	27.3					
	6	88.6	4.1					
	8	-339.5	-91.9					
	11	77.2	3.0					
BUS	6	.990	13.00	.0	16.1	52.00	22.00	
	5	-87.6	-1.3					
	7	35.3	-4.7					
BUS	7	.989	12.56	.0	.0	19.00	2.00	
	6	-35.2	4.5					
	12	16.3	-6.5					
BUS	8	1.015	20.77	-28.0	62.9	.00	.00	
	5	339.5	124.8	TAP	.985			
	9	-440.7	-82.7					
	30	73.0	27.9					
BUS	9	1.043	28.02	.0	.0	.00	.00	
	8	445.4	24.5					
	10	-445.4	-24.4					
BUS	10	1.050	35.61	450.0	-51.1	.00	.00	
	9	450.2	-51.1					
BUS	11	.985	12.72	.0	.0	70.00	23.00	
	4	-63.2	1.3					
	5	-76.0	-.6					
	12	54.0	-35.0					
	13	34.8	11.5					
BUS	12	.990	12.20	85.0	91.6	47.00	10.00	
	2	32.9	19.4					
	3	10.0	8.8					
	7	-16.3	5.7					
	11	-33.9	35.0					
	14	18.1	2.7					
	16	7.3	4.3					
	117	20.1	5.2					

BUS	13	.968	11.35	.0	.0	34.00	16.00	
		11	-34.5	-12.2				
		15	.6	-3.8				
BUS	14	.984	11.50	.0	.0	14.00	1.00	
		12	-18.0	-4.2				
		15	4.0	3.2				
BUS	15	.970	11.23	.0	3.3	90.00	30.00	
		13	-.6	-2.1				
		14	-4.0	-7.9				
		17	-103.8	-24.4				
		19	11.1	12.5				
		33	6.9	-4.8				
BUS	16	.984	11.91	.0	.0	25.00	10.00	
		12	-7.3	-6.4				
		17	-17.7	-3.6				
BUS	17	.995	13.74	.0	.0	11.00	3.00	.00
		15	105.3	25.3				
		16	17.9	-.3				
		18	80.2	24.9				
		30	-231.7	-70.4				
		31	14.8	11.5				
		113	1.9	6.1				
BUS	18	.973	11.53	.0	25.4	60.00	34.00	
		17	-79.4	-22.5				
		19	19.3	13.9				
BUS	19	.963	11.05	.0	-8.0	45.00	25.00	
		15	-11.0	-13.3				
		18	-19.2	-14.6				
		20	-10.6	5.4				
		34	-3.9	-10.5				
BUS	20	.958	11.93	.0	.0	18.00	3.00	
		19	10.7	-8.0				
		21	-28.7	5.0				
BUS	21	.959	13.52	.0	.0	14.00	8.00	
		20	28.9	-6.2				
		22	-42.9	-1.8				
BUS	22	.970	16.08	.0	.0	10.00	5.00	
		21	43.3	1.5				
		23	-53.3	-6.5				
BUS	23	1.000	21.00	.0	.0	7.00	3.00	
		22	54.4	7.4				
		24	7.6	11.0				
		25	-162.4	-26.0				
		32	93.2	4.7				
BUS	24	.992	20.89	-13.0	-13.7	.00	.00	
		23	-7.6	-15.8				
		70	-6.1	-1.5				
		72	.7	3.5				
BUS	25	1.050	27.93	220.0	49.8	.00	.00	
		23	166.6	38.4				
		26	-90.4	-18.6				
		27	143.6	30.1				
BUS	26	1.015	29.71	314.0	9.9	.00	.00	

	25	90.4	21.6	TAP	.960			
	30	223.6	-11.7					
BUS	27	.968	15.35	-9.0	3.0	62.00	13.00	
	25	-137.2	-15.2					
	28	32.9	-.6					
	32	12.4	1.1					
	115	20.7	4.7					
BUS	28	.962	13.62	.0	.0	17.00	7.00	
	27	-32.7	-.4					
	29	15.6	-6.6					
BUS	29	.963	12.63	.0	.0	24.00	4.00	
	28	-15.6	4.6					
	31	-8.6	-8.6					
BUS	30	.986	18.79	.0	.0	.00	.00	
	8	-72.7	-75.2					
	17	231.7	93.4	TAP	.960			
	26	-219.6	-36.4					
	38	60.9	18.3					
BUS	31	.967	12.75	7.0	32.1	43.00	27.00	
	17	-14.6	-14.7					
	29	8.6	7.9					
	32	-29.9	11.8					
BUS	32	.964	14.80	.0	-14.0	59.00	23.00	
	23	-90.4	-5.8					
	27	-12.4	-2.7					
	31	30.2	-13.1					
	113	4.1	-17.5					
	114	9.5	2.1					
BUS	33	.972	10.63	.0	.0	23.00	9.00	
	15	-6.9	1.8					
	37	-16.1	-10.8					
BUS	34	.986	11.30	.0	-8.0	59.00	26.00	13.61
	19	4.0	4.7					
	36	30.4	11.4					
	37	-95.3	-38.3					
	43	1.1	2.0					
BUS	35	.981	10.87	.0	.0	33.00	9.00	
	36	.2	6.3					
	37	-33.9	-15.2					
BUS	36	.980	10.87	.0	-.9	31.00	17.00	
	34	-30.3	-11.7					
	35	-.2	-6.6					
BUS	37	.992	11.77	.0	.0	.00	.00	-24.60
	33	16.3	7.8					
	34	95.6	38.4					
	35	34.0	14.6					
	38	-244.2	-86.4					
	39	54.7	3.8					
	40	43.8	-2.9					
BUS	38	.962	16.91	.0	.0	.00	.00	
	30	-60.6	-55.4					
	37	244.2	112.0	TAP	.935			
	65	-183.4	-56.5					

BUS	39	.970	8.41	.0	.0	27.00	11.00	
		37	-53.7	-3.1				
		40	26.7	-7.9				
BUS	40	.970	7.35	-46.0	27.0	20.00	23.00	
		37	-42.7	2.1				
		39	-26.5	6.9				
		41	15.3	1.3				
		42	-12.1	-6.4				
BUS	41	.967	6.92	.0	.0	37.00	10.00	
		40	-15.2	-2.3				
		42	-21.7	-7.7				
BUS	42	.985	8.53	-59.0	41.1	37.00	23.00	
		40	12.2	2.2				
		41	22.0	5.2				
		49	-65.1	5.3				
		49	-65.1	5.3				
BUS	43	.978	11.28	.0	.0	18.00	7.00	
		34	-1.1	-6.1				
		44	-16.9	-.9				
BUS	44	.985	13.82	.0	.0	16.00	8.00	9.70
		43	17.1	-4.2				
		45	-33.1	5.9				
BUS	45	.987	15.67	.0	.0	53.00	22.00	9.73
		44	33.3	-7.0				
		46	-36.5	-3.4				
		49	-49.9	-1.9				
BUS	46	1.005	18.49	19.0	-5.1	28.00	10.00	10.10
		45	37.0	1.9				
		47	-31.3	-1.1				
		48	-14.8	-5.8				
BUS	47	1.017	20.73	.0	.0	34.00	.00	
		46	31.6	-.9				
		49	-9.3	-11.0				
		69	-56.4	11.8				
BUS	48	1.021	19.93	.0	.0	20.00	11.00	15.63
		46	14.9	1.4				
		49	-35.0	3.2				
BUS	49	1.025	20.94	204.0	116.1	87.00	30.00	
		42	68.2	.4				
		42	68.2	.4				
		45	51.6	2.2				
		47	9.4	9.4				
		48	35.2	-3.9				
		50	52.7	13.4				
		51	66.7	20.4				
		54	37.8	13.1				
		54	37.8	11.2				
		66	-132.3	4.4				
		66	-132.3	4.4				
		69	-46.9	10.8				
BUS	50	1.001	18.90	.0	.0	17.00	4.00	
		49	-52.9	-13.1				
		57	35.9	9.1				
BUS	51	.967	16.28	.0	.0	17.00	8.00	

	49	-64.4	-17.4				
	52	28.6	6.2				
	58	18.8	3.2				
BUS 52	.957	15.32	.0	.0	18.00	5.00	
	51	-28.4	-7.0				
	53	10.4	2.0				
BUS 53	.946	14.35	.0	.0	23.00	11.00	
	52	-10.3	-5.4				
	54	-12.7	-5.6				
BUS 54	.955	15.26	48.0	4.0	113.00	32.00	
	49	-36.6	-15.6				
	49	-36.4	-13.8				
	53	12.7	3.0				
	55	7.1	1.5				
	56	18.3	4.4				
	59	-30.4	-7.5				
BUS 55	.952	14.97	.0	4.7	63.00	22.00	
	54	-7.1	-3.2				
	56	-21.5	-5.8				
	59	-34.6	-8.2				
BUS 56	.954	15.16	.0	-2.1	84.00	18.00	
	54	-18.3	-5.0				
	55	21.6	5.5				
	57	-23.0	-9.1				
	58	-6.7	-3.7				
	59	-28.0	-4.2				
	59	-29.3	-3.9				
BUS 57	.971	16.36	.0	.0	12.00	3.00	
	50	-35.2	-10.5				
	56	23.3	7.5				
BUS 58	.959	15.51	.0	.0	12.00	3.00	
	51	-18.7	-4.5				
	56	6.7	1.5				
BUS 59	.985	19.37	155.0	76.9	277.00	113.00	
	54	30.9	4.3				
	55	35.2	5.9				
	56	28.7	1.0				
	56	30.1	1.1				
	60	-43.3	3.6				
	61	-51.8	5.0				
	63	-151.9	-57.0				
BUS 60	.993	23.15	.0	.0	78.00	3.00	
	59	44.0	-4.4				
	61	-112.2	8.6				
	62	-9.9	-7.1				
BUS 61	.995	24.04	160.0	-40.3	.00	.00	
	59	52.7	-4.6				
	60	112.6	-8.3				
	62	25.4	-13.8				
	64	-30.7	-13.7				
BUS 62	.998	23.43	.0	1.3	77.00	14.00	
	60	10.0	5.7				
	61	-25.4	13.2				
	66	-37.2	-17.3				
	67	-24.3	-14.4				

BUS 63	.969	22.75	.0	.0	.00	.00	
59	151.9	67.5	TAP .960				
64	-152.0	-67.5					
BUS 64	.984	24.52	.0	.0	.00	.00	
61	30.7	14.0	TAP .985				
63	152.5	52.5					
65	-183.1	-66.5					
BUS 65	1.005	27.65	391.0	81.3	.00	.00	
38	186.6	-8.8					
64	184.1	40.1					
66	8.8	72.3	TAP .935				
68	11.4	-22.2					
BUS 66	1.050	27.48	392.0	-2.0	39.00	18.00	
49	135.3	8.3					
49	135.3	8.3					
62	38.0	14.7					
65	-8.8	-70.6					
67	53.2	19.3					
BUS 67	1.020	24.84	.0	.0	28.00	7.00	
62	24.5	12.1					
66	-52.5	-19.1					
BUS 68	1.003	27.55	.0	.0	.00	.00	
65	-11.4	-42.1					
69	-128.2	112.9	TAP .935				
81	-44.6	-4.6					
116	183.9	-66.2					
BUS 69	1.035	30.00	518.5	-82.7	.00	.00	
47	59.1	-10.1					
49	49.2	-12.1					
68	128.2	-103.6					
70	108.9	16.0					
75	110.3	20.4					
77	62.7	6.7					
BUS 70	.984	22.58	.0	8.3	66.00	20.00	
24	6.2	-8.3					
69	-105.4	-13.8					
71	17.4	-12.5					
74	16.1	12.9					
75	-.3	10.0					
BUS 71	.987	22.15	.0	.0	.00	.00	
70	-17.3	11.8					
72	11.3	-1.1					
73	6.0	-10.7					
BUS 72	.980	20.98	-12.0	-11.1	.00	.00	
24	-.7	-8.2					
71	-11.2	-3.0					
BUS 73	.991	21.94	-6.0	9.7	.00	.00	
71	-6.0	9.7					
BUS 74	.958	21.54	.0	-5.6	68.00	27.00	11.0
70	-15.9	-15.5					
75	-52.1	-6.1					
BUS 75	.967	22.91	.0	.0	47.00	11.00	
69	-105.5	-18.2					

	70	.3	-13.2						
	74	52.5	6.4						
	77	-34.6	-9.6						
	118	40.2	23.6						
BUS	76	.943	21.77	.0	5.3	68.00	36.00		
	77	-61.1	-21.0						
	118	-6.9	-9.7						
BUS	77	1.006	26.72	.0	12.0	61.00	28.00		
	69	-61.5	-13.6						
	75	35.4	7.4						
	76	63.2	24.4						
	78	45.4	6.6						
	80	-96.4	-37.5						
	80	-44.3	-20.6						
	82	-3.0	17.3						
BUS	78	1.003	26.42	.0	.0	71.00	26.00		
	77	-45.4	-7.6						
	79	-25.6	-18.4						
BUS	79	1.009	26.72	.0	.0	39.00	32.00	20.37	
	78	25.7	18.0						
	80	-54.7	-29.6						
BUS	80	1.040	28.96	477.0	105.1	130.00	26.00		
	77	98.2	37.6						
	77	45.0	20.6						
	79	65.4	31.1						
	81	44.6	-73.1						
	96	18.9	20.8						
	97	26.4	25.5						
	98	28.9	8.3						
	99	19.5	8.2						
BUS	81	.997	28.10	.0	.0	.00	.00		
	68	44.7	-75.6						
	80	-44.6	75.6	TAP	.935				
BUS	82	.989	27.24	.0	.0	54.00	27.00	19.55	
	77	3.1	-25.0						
	83	-47.0	24.5						
	96	-10.1	-6.9						
BUS	83	.985	28.42	.0	.0	20.00	10.00	9.69	
	82	47.4	-27.1						
	84	-24.7	14.7						
	85	-42.7	12.1						
BUS	84	.980	30.95	.0	.0	11.00	7.00		
	83	25.3	-16.0						
	85	-36.3	9.0						
BUS	85	.985	32.51	.0	-5.8	24.00	15.00		
	83	43.6	-12.4						
	84	36.7	-9.3						
	86	17.2	-7.4						
	88	-50.3	7.6						
	89	-71.2	.7						
BUS	86	.987	31.14	.0	.0	21.00	10.00		
	85	-17.0	5.1						
	87	-4.0	-15.1						
BUS	87	1.015	31.40	4.0	11.0	.00	.00		

		86	4.0	11.0				
BUS	88	.987	35.64	.0	.0	48.00	10.00	
		85	50.8	-7.5				
		89	-98.9	-2.5				
BUS	89	1.005	39.69	607.0	-12.6	.00	.00	
		85	72.4	3.7				
		88	100.2	7.7				
		90	58.2	-4.7				
		90	110.7	-5.4				
		92	201.8	-7.2				
		92	63.6	-6.7				
BUS	90	.985	33.29	-85.0	59.3	78.00	42.00	
		89	-56.4	5.8				
		89	-107.8	7.0				
		91	1.3	4.5				
BUS	91	.980	33.31	-10.0	-15.1	.00	.00	
		90	-1.3	-6.5				
		92	-8.7	-8.6				
BUS	92	.993	33.80	.0	-3.0	65.00	10.00	
		89	-197.8	22.1				
		89	-62.0	8.9				
		91	8.8	5.6				
		93	57.7	-10.6				
		94	52.3	-14.2				
		100	31.4	-17.2				
		102	44.6	-7.6				
BUS	93	.987	30.79	.0	.0	12.00	7.00	
		92	-56.8	11.4				
		94	44.8	-18.4				
BUS	94	.991	28.64	.0	.0	30.00	16.00	
		92	-50.8	14.8				
		93	-44.3	18.3				
		95	40.9	9.4				
		96	19.9	-9.4				
		100	4.3	-49.1				
BUS	95	.981	27.67	.0	.0	42.00	31.00	
		94	-40.7	-9.7				
		96	-1.3	-21.3				
BUS	96	.993	27.51	.0	.0	38.00	15.00	
		80	-18.6	-24.4				
		82	10.1	1.7				
		94	-19.7	7.5				
		95	1.4	20.1				
		97	11.1	-19.9				
BUS	97	1.011	27.88	.0	.0	15.00	9.00	
		80	-26.2	-27.0				
		96	11.2	17.9				
BUS	98	1.024	27.40	.0	.0	34.00	8.00	
		80	-28.7	-10.4				
		100	-5.3	2.4				
BUS	99	1.010	27.04	-42.0	-17.5	.00	.00	
		80	-19.3	-13.0				
		100	-22.7	-4.6				

BUS 100	1.017	28.03	252.0	108.2	37.00	18.00	
92		-30.7	12.9				
94		-3.9	44.3				
98		5.3	-7.3				
99		22.8	2.8				
101		-16.7	22.0				
103		121.1	-4.3				
104		56.4	10.6				
106		60.6	9.2				
BUS 101	.993	29.61	.0	.0	22.00	15.00	
100		17.0	-24.2				
102		-39.0	9.3				
BUS 102	.991	32.30	.0	.0	5.00	3.00	
92		-44.3	7.3				
101		39.4	-10.3				
BUS 103	1.001	24.44	40.0	40.0	23.00	16.00	
100		-118.9	6.3				
104		32.3	7.9				
105		43.0	6.5				
110		60.6	3.2				
BUS 104	.971	21.69	.0	5.7	38.00	25.00	
100		-55.0	-9.3				
103		-31.8	-10.1				
105		48.7	.1				
BUS 105	.966	20.57	.0	-8.0	31.00	26.00	18.66
103		-41.9	-7.4				
104		-48.5	-.0				
106		8.7	4.6				
107		26.7	-1.9				
108		24.0	-10.6				
BUS 106	.962	20.32	.0	.0	43.00	16.00	
100		-58.3	-6.8				
105		-8.6	-5.8				
107		24.0	-3.4				
BUS 107	.952	17.53	-22.0	5.7	28.00	12.00	5.44
105		-26.3	-1.1				
106		-23.7	.2				
BUS 108	.967	19.38	.0	.0	2.00	1.00	
105		-23.8	9.4				
109		21.8	-10.4				
BUS 109	.967	18.93	.0	.0	8.00	3.00	
108		-21.7	9.9				
110		13.7	-12.9				
BUS 110	.973	18.09	.0	4.9	39.00	30.00	5.68
103		-59.1	-1.0				
109		-13.6	11.2				
111		-35.7	1.0				
112		69.4	-30.6				
BUS 111	.980	19.74	36.0	-1.8	.00	.00	
110		36.0	-1.8				
BUS 112	.975	14.99	-43.0	41.5	25.00	13.00	
110		-68.0	28.5				
BUS 113	.993	13.74	-6.0	6.4	.00	.00	

	17	-1.9	-6.8			
	32	-3.9	13.1			
BUS 114	.960	14.46	.0	.0	8.00	3.00
	32	-9.5	-3.6			
	115	.9	.7			
BUS 115	.960	14.46	.0	.0	22.00	7.00
	27	-10.6	-6.1			
	114	-.9	-1.0			
BUS 116	1.005	27.12	-184.0	51.3	.00	.00
	68	-183.7	51.2			
BUS 117	.974	10.67	.0	.0	20.00	8.00
	12	-20.0	-8.0			
BUS 118	.949	21.92	.0	.0	33.00	15.00
	75	-39.9	-23.5			
	76	6.9	8.5			
LOSSES	132.9		784.7			
SWING 69						
MISMATCH						
		.291	.003			
		.072	-.028			
		-.008	-.004			
		1.289	.008			
		-.220	.056			
		.332	.077			
		-.046	-.003			
		.198	-.047			
		.079	-.086			
		-.196	-.026			
		.352	-.103			
		-.243	.427			
		-.048	.015			
		-.044	.013			
		.366	.042			
		-.030	.005			
		.471	-.105			
		.056	.070			
		-.140	.037			
		.035	-.012			
		.010	-.009			
		-.009	-.006			
		.231	-.072			
		-.057	.060			
		.207	.012			
		-.058	-.010			
		.250	.034			
		.017	-.005			
		.148	-.055			
		-.215	.005			
		-.075	.136			
		.001	.007			
		.000	-.001			
		.825	-.245			
		.692	-.161			
		-.508	.337			
		-.316	.097			
		-.187	-.012			
		.042	-.010			
		.056	.069			
		-.040	.011			
		-.021	.031			

-.010	.002
.020	-.007
.004	-.009
.021	.011
.027	-.010
.040	-.017
.057	.067
-.005	.002
.062	-.021
-.013	.006
.010	-.003
.305	.022
.164	.017
-.184	.219
-.030	.010
-.041	.014
.072	.015
.218	-.053
.025	.063
-.039	.043
.071	-.021
-.078	-.013
.079	.007
-.072	.011
-.032	.006
.350	-.043
-2.053	82.670
.065	.010
.031	-.007
-.024	.017
-.028	.014
.018	.008
-.001	-.001
.025	.001
.148	.007
-.012	.004
-.013	.000
.057	.024
-.079	.002
.051	-.019
-.005	-.003
.013	-.008
.021	.016
-.000	.001
-.005	.002
.012	-.005
.049	.005
.005	.014
.002	.009
.023	-.004
.008	-.002
.051	-.016
.002	-.002
-.034	.010
-.021	.003
.000	-.000
.016	.003
.025	.026
.005	-.003
-.027	.005
.008	.000
.031	.010
.020	-.007
-.015	.004
-.009	.009
.034	-.013

-.015	.005
.029	.017
-.012	.009
-.011	.016
-.164	.140
.574	-.139
-.526	.106
-.258	.060
-.041	.010
-.025	.007

ITERATION COUNT	143	
TOTAL MISMATCH	4.577	1.217
AVERAGE MISMATCH	.039	.010

AEP 118 BUS TEST SYSTEM

IMPEDANCES

GROUP 1
NO CONVERSIONS

P	C	R	X	BC/2
1	2	.03030	.09990	.01270
1	3	.01290	.04240	.00541
4	5	.00176	.00798	.00105
3	5	.02410	.10800	.01420
5	6	.01190	.05400	.00713
6	7	.00459	.02080	.00275
8	9	.00244	.03050	.58100
5	8	.00000	.02670	.00000
9	10	.00258	.03220	.61500
4	11	.02090	.06880	.00874
5	11	.02030	.06820	.00869
11	12	.00595	.01960	.00251
2	12	.01870	.05160	.00786
3	12	.04840	.16000	.02030
7	12	.00862	.03400	.00437
11	13	.02225	.07310	.00938
12	14	.02150	.07070	.00908
13	15	.07440	.24440	.03134
14	15	.05950	.19500	.02510
12	16	.02120	.08340	.01070
15	17	.01320	.04370	.02220
16	17	.04540	.18010	.02330
17	18	.01230	.05050	.00649
18	19	.01190	.04930	.00571
19	20	.02520	.11700	.01490
15	19	.01200	.03940	.00505
20	21	.01830	.08490	.01080
21	22	.02090	.09700	.01230
22	23	.03420	.15900	.02020
23	24	.01350	.04920	.02490
23	25	.01560	.08000	.04320
26	26	.00000	.03820	.00000
25	27	.03180	.16300	.08820
27	28	.01913	.08550	.01080
28	29	.02370	.09430	.01190
17	30	.00000	.03880	.00000
8	30	.00431	.05040	.25700
26	30	.00799	.08600	.45400
17	31	.04740	.15630	.01995
29	31	.01080	.03310	.00415
23	32	.03170	.11530	.05865
31	32	.02980	.09850	.01255
27	32	.02290	.07550	.00963
15	33	.03800	.12440	.01597
19	34	.07520	.24700	.03160
35	36	.00224	.01020	.00134
35	37	.01100	.04970	.00659
33	37	.04150	.14200	.01830
34	36	.00871	.02680	.00284
34	37	.00256	.00940	.00492
37	38	.00000	.03750	.00000
37	39	.03210	.10600	.01350
37	40	.05930	.16800	.02100
30	38	.00464	.05400	.21100
39	40	.01840	.06050	.00776

40	41	.01450	.04780	.00611
40	42	.05550	.18300	.02330
41	42	.04100	.13500	.01720
43	44	.06080	.24540	.03034
34	43	.04130	.16810	.02113
44	45	.02240	.09010	.01120
45	46	.04000	.13560	.01660
45	47	.03800	.12700	.01580
46	48	.06010	.18900	.02360
47	49	.01910	.06250	.00802
42	49	.07150	.32300	.04300
42	49	.07150	.32300	.04300
45	49	.06840	.18600	.02220
48	49	.01790	.05050	.00629
49	50	.02670	.07520	.00937
49	51	.04860	.13700	.01710
51	52	.02030	.05880	.00698
52	53	.04050	.16350	.02029
53	54	.02630	.12200	.01550
49	54	.07300	.28900	.03690
49	54	.08690	.29100	.03650
54	55	.01690	.07070	.01010
54	56	.00275	.00955	.00366
55	56	.00488	.01510	.00187
56	57	.03430	.09660	.01210
50	57	.04740	.13400	.01660
56	58	.03430	.09660	.01210
51	58	.02550	.07190	.00894
54	59	.05030	.22930	.02990
56	59	.08250	.25100	.02845
58	59	.08030	.23900	.02680
55	59	.04739	.21580	.02823
59	60	.03170	.14500	.01880
59	61	.03280	.15000	.01940
60	61	.00264	.01350	.00728
60	62	.01230	.05610	.00734
61	62	.00824	.03760	.00490
59	63	.00000	.03860	.00000
63	64	.00172	.02000	.10800
61	64	.00000	.02680	.00000
38	65	.00901	.09860	.52300
64	65	.00269	.03020	.19000
49	66	.01800	.09190	.01240
49	66	.01800	.09190	.01240
62	66	.04820	.21800	.02890
62	67	.02580	.11700	.01550
65	56	.00000	.03700	.00000
66	67	.02240	.10150	.01341
65	68	.00138	.01600	.31900
47	69	.08440	.27780	.03546
49	69	.09850	.32400	.04140
68	69	.00000	.03700	.00000
69	70	.03000	.12700	.06100
24	70	.10221	.41150	.05099
70	71	.00882	.03550	.00439
24	72	.04880	.19600	.02440
71	72	.04460	.18300	.02220
71	73	.00866	.04540	.00589
70	74	.04010	.13230	.01684
70	75	.04280	.14100	.01800
69	75	.04050	.12200	.06200
74	75	.01230	.04060	.00517
74	77	.04440	.14800	.01840
69	77	.03090	.10100	.05190
75	77	.06010	.19990	.02489
77	78	.00376	.01240	.00632

78	79	.00546	.02440	.00324
77	80	.01700	.04850	.02360
77	80	.02940	.10500	.01140
79	80	.01560	.07040	.00935
68	81	.00175	.02020	.40400
80	81	.00000	.03700	.00000
77	82	.02980	.08530	.04087
82	83	.01120	.03665	.01898
83	84	.06250	.13200	.01290
83	85	.04300	.14800	.01740
84	85	.03020	.06410	.00617
85	86	.03500	.12300	.01380
86	87	.02828	.20740	.02225
85	88	.02000	.10200	.01380
85	89	.02390	.17300	.02350
88	89	.01390	.07120	.00967
89	90	.05180	.18800	.02640
89	90	.02380	.09970	.05300
90	91	.02540	.08360	.01070
89	92	.00990	.05050	.02740
89	92	.03930	.15810	.02070
91	92	.03870	.12720	.01634
92	93	.02580	.08480	.01090
92	94	.04810	.15800	.02030
93	94	.02230	.07320	.00938
94	95	.01320	.04340	.00555
80	96	.03560	.18200	.02470
82	96	.01620	.05300	.02720
94	96	.02690	.08690	.01150
80	97	.01830	.09340	.01270
80	98	.02380	.10800	.01430
80	99	.04540	.20600	.02730
92	100	.06480	.29500	.03860
94	100	.01780	.05800	.03020
95	96	.01710	.05470	.00737
96	97	.01730	.08850	.01200
98	100	.03970	.17900	.02380
99	100	.01800	.08130	.01080
100	101	.02770	.12620	.01640
92	102	.01230	.05590	.00732
101	102	.02460	.11200	.01470
100	103	.01600	.05250	.02680
100	104	.04510	.20400	.02705
103	104	.04660	.15840	.02035
103	105	.05350	.16250	.02040
100	106	.06050	.22900	.03100
104	105	.00994	.03780	.00493
105	106	.01400	.05470	.00717
105	107	.05300	.18300	.02360
105	108	.02610	.07030	.00922
106	107	.05300	.18300	.02360
108	109	.01050	.02880	.00380
103	110	.03906	.18130	.02305
109	110	.02780	.07620	.01010
110	111	.02200	.07550	.01000
110	112	.02470	.06400	.03100
17	113	.00913	.03010	.00384
32	113	.06150	.20300	.02590
32	114	.01350	.06120	.00814
27	115	.01640	.07410	.00986
114	115	.00230	.01040	.00138
68	116	.00034	.00405	.00200
12	117	.03290	.14000	.01790
75	118	.01450	.04810	.00599
76	118	.01640	.05440	.00678

ADMITTANCES (100 MVA BASE)

P	Q	G	B	BC/2
1	2	2.78030	9.16674	.01270
1	3	6.56766	21.58673	.00541
2	1	2.78030	9.16674	.01270
2	12	4.51228	14.86397	.00786
3	1	6.56766	21.58673	.00541
3	5	1.96818	8.82006	.01420
3	12	1.73212	5.72603	.02030
4	5	26.35599	119.50043	.00105
4	11	4.04236	13.30690	.00874
5	3	1.96818	8.82006	.01420
5	4	26.35599	119.50043	.00105
5	6	3.89193	17.66085	.00713
5	8	.00000	37.45318	.00000
5	11	4.00922	13.46940	.00869
6	5	3.89193	17.66085	.00713
6	7	10.11664	45.84445	.00275
7	6	10.11664	45.84445	.00275
7	12	7.00640	27.63544	.00437
8	5	.00000	37.45318	.00000
8	9	2.60627	32.57838	.58100
8	30	1.68443	19.69723	.25700
9	8	2.60627	32.57838	.58100
9	10	2.47246	30.85780	.61500
10	9	2.47246	30.85780	.61500
11	4	4.04236	13.30690	.00874
11	5	4.00922	13.46940	.00869
11	12	14.18144	46.71533	.00251
11	13	3.81080	12.51997	.00938
12	2	4.51228	14.86397	.00786
12	3	1.73212	5.72603	.02030
12	7	7.00640	27.63544	.00437
12	11	14.18144	46.71533	.00251
12	14	3.93720	12.94696	.00908
12	16	2.86293	11.26266	.01070
12	117	1.59072	6.76904	.01790
13	11	3.81080	12.51997	.00938
13	15	1.13994	3.74463	.03134
14	12	3.93720	12.94696	.00908
14	15	1.43148	4.69142	.02510
15	13	1.13994	3.74463	.03134
15	14	1.43148	4.69142	.02510
15	17	6.33419	20.96999	.02220
15	19	7.07397	23.22620	.00505
15	33	2.24595	7.35252	.01597
16	12	2.86293	11.26266	.01070
16	17	1.31605	5.22072	.02330
17	15	6.33419	20.96999	.02220
17	16	1.31605	5.22072	.02330
17	18	4.55296	18.69304	.00649
17	30	.00000	25.77320	.00000
17	31	1.77685	5.85910	.01995
17	113	9.22812	30.42350	.00384
18	17	4.55296	18.69304	.00649
18	19	4.62657	19.16722	.00571
19	15	7.07397	23.22620	.00505
19	18	4.62657	19.16722	.00571
19	20	1.75928	8.16809	.01490
19	34	1.12804	3.70515	.03160
20	19	1.75928	8.16809	.01490
20	21	2.42612	11.25562	.01080
21	20	2.42612	11.25562	.01080
21	22	2.12273	9.85191	.01230
22	21	2.12273	9.85191	.01230

22	23	1.29297	6.01120	.02020
23	22	1.29297	6.01120	.02020
23	24	5.18654	18.90207	.02490
23	25	2.34821	12.04210	.04320
23	32	2.21694	8.06351	.05865
24	23	5.18654	18.90207	.02490
24	70	.56853	2.28892	.05099
24	72	1.19615	4.80422	.02440
25	23	2.34821	12.04210	.04320
25	26	.00000	26.17801	.00000
25	27	1.15300	5.91003	.08820
26	25	.00000	26.17801	.00000
26	30	1.07107	11.52840	.45400
27	25	1.15300	5.91003	.08820
27	28	2.49212	11.13831	.01080
27	32	3.67892	12.12918	.00963
27	115	2.84734	12.86510	.00986
28	27	2.49212	11.13831	.01080
28	29	2.50683	9.97442	.01190
29	28	2.50683	9.97442	.01190
29	31	8.90905	27.30460	.00415
30	8	1.68443	19.69723	.25700
30	17	.00000	25.77320	.00000
30	26	1.07107	11.52840	.45400
30	38	1.57956	18.38279	.21100
31	17	1.77685	5.85910	.01995
31	29	8.90905	27.30460	.00415
31	32	2.81390	9.30097	.01255
32	23	2.21694	8.06351	.05865
32	27	3.67892	12.12918	.00963
32	31	2.81390	9.30097	.01255
32	113	1.36693	4.51199	.02590
32	114	3.43713	15.58168	.00814
33	15	2.24595	7.35252	.01597
33	37	1.89617	6.48809	.01830
34	19	1.12804	3.70515	.03160
34	36	10.96834	33.74872	.00284
34	37	26.97190	99.03744	.00492
34	43	1.37835	5.61020	.02113
35	36	20.53960	93.52856	.00134
35	37	4.24532	19.18112	.00659
36	34	10.96834	33.74872	.00284
36	35	20.53960	93.52856	.00134
37	33	1.89617	6.48809	.01830
37	34	26.97190	99.03744	.00492
37	35	4.24532	19.18112	.00659
37	38	.00000	26.66667	.00000
37	39	2.61690	8.64149	.01350
37	40	1.86828	5.29292	.02100
38	30	1.57956	18.38279	.21100
38	37	.00000	26.66667	.00000
38	65	.91909	10.05800	.52300
39	37	2.61690	8.64149	.01350
39	40	4.60137	15.12950	.00776
40	37	1.86828	5.29292	.02100
40	39	4.60137	15.12950	.00776
40	41	5.81141	19.15763	.00611
40	42	1.51767	5.00420	.02330
41	40	5.81141	19.15763	.00611
41	42	2.05968	6.78187	.01720
42	40	1.51767	5.00420	.02330
42	41	2.05968	6.78187	.01720
42	49	.65332	2.95136	.04300
42	49	.65332	2.95136	.04300
43	34	1.37835	5.61020	.02113
43	44	.95122	3.83931	.03034

44	43	.95122	3.83931	.03034
44	45	2.59868	10.45272	.01120
45	44	2.59868	10.45272	.01120
45	46	2.00126	6.78429	.01660
45	49	1.74159	4.73589	.02220
46	45	2.00126	6.78429	.01660
46	47	2.16241	7.22700	.01580
46	48	1.52798	4.80512	.02360
47	46	2.16241	7.22700	.01580
47	49	4.47196	14.63337	.00802
47	69	1.00123	3.29552	.03546
48	46	1.52798	4.80512	.02360
48	49	6.23550	17.59177	.00629
49	42	.65332	2.95136	.04300
49	42	.65332	2.95136	.04300
49	45	1.74159	4.73589	.02220
49	47	4.47196	14.63337	.00802
49	48	6.23550	17.59177	.00629
49	50	4.19289	11.80918	.00937
49	51	2.29994	6.48338	.01710
49	54	.82161	3.25267	.03690
49	54	.94218	3.15507	.03650
49	66	2.05254	10.47937	.01240
49	66	2.05254	10.47937	.01240
49	69	.85892	2.82530	.04140
50	49	4.19289	11.80918	.00937
50	57	2.34621	6.63276	.01660
51	49	2.29994	6.48338	.01710
51	52	5.24612	15.19564	.00698
51	58	4.38155	12.35425	.00894
52	51	5.24612	15.19564	.00698
52	53	1.42744	5.76262	.02029
53	52	1.42744	5.76262	.02029
53	54	1.68853	7.83272	.01550
54	49	.82161	3.25267	.03690
54	49	.94218	3.15507	.03650
54	53	1.68853	7.83272	.01550
54	55	3.19827	13.37976	.01010
54	56	27.84387	96.69417	.00366
54	59	.91274	4.16088	.02990
55	54	3.19827	13.37976	.01010
55	56	19.37858	59.96242	.00187
55	59	.97080	4.42073	.02823
56	54	27.84387	96.69417	.00366
56	55	19.37858	59.96242	.00187
56	57	3.26416	9.19295	.01210
56	58	3.26416	9.19295	.01210
56	59	1.18183	3.59562	.02845
56	59	1.26319	3.75969	.02680
57	50	2.34621	6.63276	.01660
57	56	3.26416	9.19295	.01210
58	51	4.38155	12.35425	.00894
58	56	3.26416	9.19295	.01210
59	54	.91274	4.16088	.02990
59	55	.97080	4.42073	.02823
59	56	1.18183	3.59562	.02845
59	56	1.26319	3.75969	.02680
59	60	1.43895	6.58197	.01880
59	61	1.39125	6.36245	.01940
59	63	.00000	25.90674	.00000
60	59	1.43895	6.58197	.01080
60	61	13.95204	71.34567	.00728
60	62	3.72897	17.00773	.00734
61	59	1.39125	6.36245	.01940
61	60	13.95204	71.34567	.00728
61	62	5.56134	25.37698	.00490

61	64	.00000	37.31343	.00000
62	60	3.72897	17.00773	.00734
62	61	5.56134	25.37698	.00490
62	66	.96695	4.37336	.02890
62	67	1.79733	8.15067	.01550
63	59	.00000	25.90674	.00000
63	64	4.26843	49.63292	.10800
64	61	.00000	37.31343	.00000
64	63	4.26843	49.63292	.10800
64	65	2.92622	32.85194	.19000
65	38	.91909	10.05800	.52300
65	64	2.92622	32.85194	.19000
65	66	.00000	27.02703	.00000
65	68	5.35082	62.03849	.31900
66	49	2.05254	10.47937	.01240
66	49	2.05254	10.47937	.01240
66	62	.96695	4.37336	.02890
66	65	.00000	27.02703	.00000
66	67	2.07330	9.39466	.01341
67	62	1.79733	8.15067	.01550
67	66	2.07330	9.39466	.01341
68	65	5.35082	62.03849	.31900
68	69	.00000	27.02703	.00000
68	81	4.25685	49.13616	.40400
68	116	20.58348	245.18559	.08200
69	47	1.00123	3.29552	.03546
69	49	.85892	2.82530	.04140
69	68	.00000	27.02703	.00000
69	70	1.76170	7.45787	.06100
69	75	2.45094	7.38309	.06200
69	77	2.76986	9.05358	.05190
70	24	.56853	2.28892	.05099
70	69	1.76170	7.45787	.06100
70	71	6.59172	26.53130	.00439
70	74	2.09824	6.92261	.01684
70	75	1.97118	6.49385	.01800
71	70	6.59172	26.53130	.00439
71	72	1.29692	5.23421	.02220
71	73	4.05401	21.25313	.00589
72	24	1.19615	4.80422	.02440
72	71	1.29692	5.23421	.02220
73	71	4.05401	21.25313	.00589
74	70	2.09824	6.92261	.01684
74	75	6.83466	22.55994	.00517
75	69	2.45094	7.38309	.06200
75	70	1.97118	6.49385	.01800
75	74	6.83466	22.55994	.00517
75	77	1.37933	4.58781	.02489
75	118	5.74517	19.05811	.00599
76	77	1.85966	6.19886	.01840
76	118	5.08004	16.85087	.00678
77	69	2.76986	9.05358	.05190
77	75	1.37933	4.58781	.02489
77	76	1.85966	6.19886	.01840
77	78	22.39460	73.85454	.00632
77	80	6.43635	18.36252	.02360
77	80	2.47280	8.83143	.01140
77	82	3.65011	10.44814	.04087
78	77	22.39460	73.85454	.00632
78	79	8.73360	39.02928	.00324
79	78	8.73360	39.02928	.00324
79	80	3.00028	13.53971	.00935
80	77	6.43635	18.36252	.02360
80	77	2.47280	8.83143	.01140
80	79	3.00028	13.53971	.00935
80	81	.00000	27.02703	.00000

80	96	1.03514	5.29203	.02470
80	97	2.02021	10.31081	.01270
80	98	1.94596	8.83043	.01430
80	99	1.02029	4.62951	.02730
81	68	4.25685	49.13616	.40400
81	80	.00000	27.02703	.00000
82	77	3.65011	10.44814	.04087
82	83	7.62599	24.95468	.01898
82	96	5.27440	17.25575	.02720
83	82	7.62599	24.95468	.01898
83	84	2.93011	6.18839	.01290
83	85	1.81030	6.23079	.01740
84	83	2.93011	6.18839	.01290
84	85	6.01492	12.76676	.00617
85	83	1.81030	6.23079	.01740
85	84	6.01492	12.76676	.00617
85	86	2.14015	7.52110	.01380
85	88	1.85117	9.44095	.01380
85	89	.78360	5.67209	.02350
86	85	2.14015	7.52110	.01380
86	87	.64545	4.73359	.02225
87	86	.64545	4.73359	.02225
88	85	1.85117	9.44095	.01380
88	89	2.64125	13.52931	.00967
89	85	.78360	5.67209	.02350
89	88	2.64125	13.52931	.00967
89	90	1.36218	4.94382	.02640
89	90	2.26526	9.48934	.05300
89	92	3.73830	19.06912	.02740
89	92	1.48078	5.95702	.02070
90	89	1.36218	4.94382	.02640
90	89	2.26526	9.48934	.05300
90	91	3.32717	10.95084	.01070
91	90	3.32717	10.95084	.01070
91	92	2.18922	7.19558	.01634
92	89	3.73830	19.06912	.02740
92	89	1.48078	5.95702	.02070
92	91	2.18922	7.19558	.01634
92	93	3.28383	10.79336	.01090
92	94	1.76335	5.79230	.02030
92	100	.71034	3.23380	.03860
92	102	3.75446	17.06297	.00732
93	92	3.28383	10.79336	.01090
93	94	3.80837	12.50100	.00938
94	92	1.76335	5.79230	.02030
94	93	3.80837	12.50100	.00938
94	95	6.41462	21.09049	.00555
94	96	3.25067	10.50123	.01150
94	100	4.83585	15.75727	.03020
95	94	6.41462	21.09049	.00555
95	96	5.20627	16.65398	.00737
96	80	1.03514	5.29203	.02470
96	82	5.27440	17.25575	.02720
96	94	3.25067	10.50123	.01150
96	95	5.20627	16.65398	.00737
96	97	2.12752	10.88355	.01200
97	80	2.02021	10.31081	.01270
97	96	2.12752	10.88355	.01200
98	80	1.94596	8.83043	.01430
98	100	1.18095	5.32467	.02380
99	80	1.02029	4.62951	.02730
99	100	2.59602	11.72536	.01080
100	92	.71034	3.23380	.03860
100	94	4.83585	15.75727	.03020
100	98	1.18095	5.32467	.02380
100	99	2.59602	11.72536	.01080

100	101	1.65931	7.55972	.01640
100	103	5.31164	17.42883	.02680
100	104	1.03322	4.67354	.02705
100	106	1.07841	4.08191	.03100
101	100	1.65931	7.55972	.01640
101	102	1.87084	8.51765	.01470
102	92	3.75446	17.06297	.00732
102	101	1.87084	8.51765	.01470
103	100	5.31164	17.42883	.02680
103	104	1.70933	5.81026	.02035
103	105	1.82790	5.55204	.02040
103	110	1.13562	5.27106	.02305
104	100	1.03322	4.67354	.02705
104	103	1.70933	5.81026	.02035
104	105	6.50675	24.74399	.00493
105	103	1.82790	5.55204	.02040
105	104	6.50675	24.74399	.00493
105	106	4.39134	17.15761	.00717
105	107	1.46014	5.04160	.02360
105	108	4.64140	12.50156	.00922
106	100	1.07841	4.08191	.03100
106	105	4.39134	17.15761	.00717
106	107	1.46014	5.04160	.02360
107	105	1.46014	5.04160	.02360
107	106	1.46014	5.04160	.02360
108	105	4.64140	12.50156	.00922
108	109	11.17390	30.64841	.00380
109	108	11.17390	30.64841	.00380
109	110	4.22539	11.58181	.01010
110	103	1.13562	5.27106	.02305
110	109	4.22539	11.58181	.01010
110	111	3.55742	12.20843	.01000
110	112	5.24852	13.59940	.03100
111	110	3.55742	12.20843	.01000
112	110	5.24852	13.59940	.03100
113	17	9.22812	30.42350	.00384
113	32	1.36693	4.51199	.02590
114	32	3.43713	15.58168	.00814
114	115	20.27325	91.67034	.00138
115	27	2.84734	12.86510	.00986
115	114	20.27325	91.67034	.00138
116	68	20.58348	245.18559	.08200
117	12	1.59072	6.76904	.01790
118	75	5.74517	19.05811	.00599
118	76	5.08004	16.85087	.00678

THESE ADMITTANCES WRITTEN IN BINARY ON TAPE NO. 1
AS RECORD NO. 1

Appendix D

IEEE 118 Bus Network

FDLF Based Results

D.1. Transmission line data
Transformer data
Shunt element data

D.2. Bus oriented results

D.3. Line flow results

Sbase: 100.

Transmission Lines

NO	NE	R %	X %	X/R	wC*Sbase	Length
BUS 1	BUS 2	3.030	9.990	3.30	2.540	48.0
BUS 1	BUS 3	1.290	4.240	3.29	1.082	20.4
BUS 4	BUS 5	.176	.798	4.53	.210	3.2
BUS 3	BUS 5	2.410	10.800	4.48	2.840	43.7
BUS 5	BUS 6	1.190	5.400	4.54	1.426	21.7
BUS 6	BUS 7	.459	2.080	4.53	.550	8.4
BUS 8	BUS 9	.244	3.050	12.50	116.200	90.5
BUS 9	BUS 10	.258	3.220	12.48	123.000	95.6
BUS 4	BUS 11	2.090	6.880	3.29	1.748	33.1
BUS 5	BUS 11	2.030	6.820	3.36	1.738	32.4
BUS 11	BUS 12	.595	1.960	3.29	.502	9.4
BUS 2	BUS 12	1.870	6.160	3.29	1.572	29.6
BUS 3	BUS 12	4.840	16.000	3.31	4.060	76.8
BUS 7	BUS 12	.862	3.400	3.94	.874	14.7
BUS 11	BUS 13	2.225	7.310	3.29	1.876	35.2
BUS 12	BUS 14	2.150	7.070	3.29	1.816	34.0
BUS 13	BUS 15	7.440	24.440	3.28	6.268	117.8
BUS 14	BUS 15	5.950	19.500	3.28	5.020	94.1
BUS 12	BUS 16	2.120	8.340	3.93	2.140	36.2
BUS 15	BUS 17	1.320	4.370	3.31	4.440	21.0
BUS 16	BUS 17	4.540	18.010	3.97	4.660	77.9
BUS 17	BUS 18	1.230	5.050	4.11	1.298	21.4
BUS 18	BUS 19	1.190	4.930	4.14	1.142	20.8
BUS 19	BUS 20	2.520	11.700	4.64	2.980	46.5
BUS 15	BUS 19	1.200	3.940	3.28	1.010	19.0
BUS 20	BUS 21	1.830	8.490	4.64	2.160	33.8
BUS 21	BUS 22	2.090	9.700	4.64	2.460	38.6
BUS 22	BUS 23	3.420	15.900	4.65	4.040	63.2
BUS 23	BUS 24	1.350	4.920	3.64	4.980	22.3
BUS 23	BUS 25	1.560	8.000	5.13	8.640	30.3
BUS 25	BUS 27	3.180	16.300	5.13	17.640	61.7
BUS 27	BUS 28	1.913	8.550	4.47	2.160	34.7
BUS 28	BUS 29	2.370	9.430	3.98	2.380	40.7
BUS 8	BUS 30	.431	5.040	11.69	51.400	154.3
BUS 26	BUS 30	.799	8.600	10.76	90.800	274.2
BUS 17	BUS 31	4.740	15.630	3.30	3.990	75.2
BUS 29	BUS 31	1.080	3.310	3.06	.830	16.6
BUS 23	BUS 32	3.170	11.530	3.64	11.730	52.3
BUS 31	BUS 32	2.980	9.850	3.31	2.510	47.3
BUS 27	BUS 32	2.290	7.550	3.30	1.926	36.3
BUS 15	BUS 33	3.800	12.440	3.27	3.194	60.1
BUS 19	BUS 34	7.520	24.700	3.28	6.320	119.0
BUS 35	BUS 36	.224	1.020	4.55	.268	4.1
BUS 35	BUS 37	1.100	4.970	4.52	1.318	20.0
BUS 33	BUS 37	4.150	14.200	3.42	3.660	66.8
BUS 34	BUS 36	.871	2.680	3.08	.568	13.4
BUS 34	BUS 37	.256	.940	3.67	.984	4.2
BUS 37	BUS 39	3.210	10.600	3.30	2.700	50.9
BUS 37	BUS 40	5.930	16.800	2.83	4.200	88.7
BUS 30	BUS 38	.464	5.400	11.64	42.200	165.7
BUS 39	BUS 40	1.840	6.050	3.29	1.552	29.1

NO	NE	R %	X %	X/R	wC*Sbase	Length
BUS 40	BUS 41	1.450	4.780	3.30	1.222	23.0
BUS 40	BUS 42	5.550	18.300	3.30	4.660	88.0
BUS 41	BUS 42	4.100	13.500	3.29	3.440	65.0
BUS 43	BUS 44	6.080	24.540	4.04	6.068	105.1
BUS 34	BUS 43	4.130	16.810	4.07	4.226	71.7
BUS 44	BUS 45	2.240	9.010	4.02	2.240	38.7
BUS 45	BUS 46	4.000	13.560	3.39	3.320	64.1
BUS 46	BUS 47	3.800	12.700	3.34	3.160	60.6
BUS 46	BUS 48	6.010	18.900	3.14	4.720	93.5
BUS 47	BUS 49	1.910	6.250	3.27	1.604	30.2
BUS 42	BUS 49	7.150	32.300	4.52	8.600	130.3
BUS 42	BUS 49	7.150	32.300	4.52	8.600	130.3
BUS 45	BUS 49	6.840	18.600	2.72	4.440	100.8
BUS 48	BUS 49	1.790	5.050	2.82	1.258	26.7
BUS 49	BUS 50	2.670	7.520	2.82	1.874	39.8
BUS 49	BUS 51	4.860	13.700	2.82	3.420	72.5
BUS 51	BUS 52	2.030	5.880	2.90	1.396	30.6
BUS 52	BUS 53	4.050	16.350	4.04	4.060	70.0
BUS 53	BUS 54	2.630	12.200	4.64	2.100	48.5
BUS 49	BUS 54	7.300	28.900	3.96	7.380	125.1
BUS 49	BUS 54	8.690	29.100	3.35	7.300	138.6
BUS 54	BUS 55	1.690	7.070	4.18	2.020	29.7
BUS 54	BUS 56	.275	.955	3.47	.732	4.5
BUS 55	BUS 56	.488	1.510	3.09	.374	7.5
BUS 56	BUS 57	3.430	9.660	2.82	2.420	51.2
BUS 50	BUS 57	4.740	13.400	2.83	3.320	70.8
BUS 56	BUS 58	3.430	9.660	2.82	2.420	51.2
BUS 51	BUS 58	2.550	7.190	2.82	1.788	38.1
BUS 54	BUS 59	5.030	22.930	4.56	5.980	92.0
BUS 56	BUS 59	8.250	25.100	3.04	5.690	126.7
BUS 56	BUS 59	8.030	23.900	2.98	5.360	122.3
BUS 55	BUS 59	4.739	21.580	4.55	5.646	86.7
BUS 59	BUS 60	3.170	14.500	4.57	3.760	58.1
BUS 59	BUS 61	3.280	15.000	4.57	3.880	60.1
BUS 60	BUS 61	.264	1.350	5.11	1.456	5.1
BUS 60	BUS 62	1.230	5.610	4.56	1.468	22.5
BUS 61	BUS 62	.824	3.760	4.56	.980	15.1
BUS 63	BUS 64	.172	2.000	11.63	21.600	61.4
BUS 38	BUS 65	.901	9.860	10.94	104.600	311.8
BUS 64	BUS 65	.269	3.020	11.23	38.000	94.3
BUS 49	BUS 66	1.800	9.190	5.11	2.480	34.8
BUS 49	BUS 66	1.800	9.190	5.11	2.480	34.8
BUS 62	BUS 66	4.820	21.800	4.52	5.980	87.9
BUS 62	BUS 67	2.580	11.700	4.53	3.100	47.1
BUS 66	BUS 67	2.240	10.150	4.53	2.682	40.9
BUS 65	BUS 68	.138	1.600	11.59	63.800	49.2
BUS 47	BUS 69	8.440	27.780	3.29	7.092	133.7
BUS 49	BUS 69	9.850	32.400	3.29	8.280	156.0
BUS 69	BUS 70	3.000	12.700	4.23	12.200	53.0
BUS 24	BUS 70	10.221	41.150	4.03	10.200	176.5
BUS 70	BUS 71	.882	3.550	4.02	.880	15.2
BUS 24	BUS 72	4.880	19.600	4.02	4.880	84.2

NO	NE	R %	X %	X/R	wC*Sbase	Length
BUS 71	BUS 72	4.460	18.000	4.04	4.444	77.1
BUS 71	BUS 73	.866	4.540	5.24	1.180	17.0
BUS 70	BUS 74	4.010	13.230	3.30	3.368	63.6
BUS 70	BUS 75	4.280	14.100	3.29	3.600	67.8
BUS 69	BUS 75	4.050	12.200	3.01	12.400	62.0
BUS 74	BUS 75	1.230	4.060	3.30	1.034	19.5
BUS 76	BUS 77	4.440	14.800	3.33	3.680	70.7
BUS 69	BUS 77	3.090	10.100	3.27	10.400	48.8
BUS 75	BUS 77	6.010	19.990	3.33	5.000	95.6
BUS 77	BUS 78	.376	1.240	3.30	1.264	6.0
BUS 78	BUS 79	.546	2.440	4.47	.648	9.9
BUS 77	BUS 80	1.700	4.850	2.85	4.720	25.5
BUS 77	BUS 80	2.940	10.500	3.57	2.280	48.2
BUS 79	BUS 80	1.560	7.040	4.51	1.870	28.4
BUS 68	BUS 81	.175	2.020	11.54	80.800	62.2
BUS 77	BUS 82	2.980	8.530	2.86	8.180	44.7
BUS 82	BUS 83	1.120	3.665	3.27	3.800	17.7
BUS 83	BUS 84	6.250	13.200	2.11	2.600	8.2
BUS 83	BUS 85	4.300	14.800	3.44	3.480	69.4
BUS 84	BUS 85	3.020	6.410	2.12	1.234	4.0
BUS 85	BUS 86	3.500	12.300	3.51	2.760	57.0
BUS 86	BUS 87	2.828	20.740	7.33	4.450	201.5
BUS 85	BUS 88	2.000	10.200	5.10	2.760	38.7
BUS 85	BUS 89	2.390	17.300	7.24	4.700	169.1
BUS 88	BUS 89	1.390	7.120	5.12	1.934	27.0
BUS 89	BUS 90	5.180	18.800	3.63	5.280	85.5
BUS 89	BUS 90	2.380	9.970	4.19	10.600	41.8
BUS 90	BUS 91	2.540	8.360	3.29	2.140	40.2
BUS 89	BUS 92	.990	5.050	5.10	5.480	19.2
BUS 89	BUS 92	3.930	15.810	4.02	4.140	67.8
BUS 91	BUS 92	3.870	12.720	3.29	3.268	61.3
BUS 92	BUS 93	2.580	8.480	3.29	2.180	40.9
BUS 92	BUS 94	4.810	15.800	3.28	4.060	76.1
BUS 93	BUS 94	2.230	7.320	3.28	1.876	35.3
BUS 94	BUS 95	1.320	4.340	3.29	1.110	20.9
BUS 80	BUS 96	3.560	18.200	5.11	4.940	69.0
BUS 82	BUS 96	1.620	5.300	3.27	5.440	25.6
BUS 94	BUS 96	2.690	8.690	3.23	2.300	42.3
BUS 80	BUS 97	1.830	9.340	5.10	2.540	35.4
BUS 80	BUS 98	2.380	10.800	4.54	2.860	43.5
BUS 80	BUS 99	4.540	20.600	4.54	5.460	82.9
BUS 92	BUS 100	6.480	29.500	4.55	7.720	118.5
BUS 94	BUS 100	1.780	5.800	3.26	6.040	28.1
BUS 95	BUS 96	1.710	5.470	3.20	1.474	26.8
BUS 96	BUS 97	1.730	8.850	5.12	2.400	33.5
BUS 98	BUS 100	3.970	17.900	4.51	4.760	72.3
BUS 99	BUS 100	1.800	8.130	4.52	2.160	32.8
BUS 100	BUS 101	2.770	12.620	4.56	3.280	50.7
BUS 92	BUS 102	1.230	5.590	4.54	1.464	22.5
BUS 101	BUS 102	2.460	11.200	4.55	2.940	45.0
BUS 100	BUS 103	1.600	5.250	3.28	5.360	25.3
BUS 100	BUS 104	4.510	20.400	4.52	5.510	82.2

NO	NE	R %	X %	X/R	wC*Sbase	Length
BUS 103	BUS 104	4.660	15.840	3.40	4.070	74.8
BUS 103	BUS 105	5.350	16.250	3.04	4.080	82.1
BUS 100	BUS 106	6.050	22.900	3.79	6.200	101.6
BUS 104	BUS 105	.994	3.780	3.80	.986	16.7
BUS 105	BUS 106	1.400	5.470	3.91	1.434	23.9
BUS 105	BUS 107	5.300	18.300	3.45	4.720	85.6
BUS 105	BUS 108	2.610	7.030	2.69	1.844	38.3
BUS 106	BUS 107	5.300	18.300	3.45	4.720	85.6
BUS 108	BUS 109	1.050	2.880	2.74	.760	15.5
BUS 103	BUS 110	3.906	18.130	4.64	4.710	72.1
BUS 109	BUS 110	2.780	7.620	2.74	2.020	41.1
BUS 110	BUS 111	2.200	7.550	3.43	2.000	35.5
BUS 110	BUS 112	2.470	6.400	2.59	6.200	35.8
BUS 17	BUS 113	.913	3.010	3.30	.768	14.5
BUS 32	BUS 113	6.150	20.300	3.30	5.180	97.5
BUS 32	BUS 114	1.350	6.120	4.53	1.626	24.6
BUS 27	BUS 115	1.640	7.410	4.52	1.972	29.9
BUS 114	BUS 115	.230	1.040	4.52	.276	4.2
BUS 68	BUS 116	.034	.405	11.91	16.400	12.3
BUS 12	BUS 117	3.290	14.000	4.26	3.580	58.3
BUS 75	BUS 118	1.450	4.810	3.32	1.200	23.0
BUS 76	BUS 118	1.640	5.440	3.32	1.356	26.1

Transformers

NO	NE	R %	X %	Tap
BUS 8	BUS 5	.000	2.670	.985
BUS 26	BUS 25	.000	3.820	.960
BUS 30	BUS 17	.000	3.880	.960
BUS 38	BUS 37	.000	3.750	.935
BUS 63	BUS 59	.000	3.860	.960
BUS 64	BUS 61	.000	2.680	.985
BUS 65	BUS 66	.000	3.700	.935
BUS 68	BUS 69	.000	3.700	.935
BUS 81	BUS 80	.000	3.700	.935

Shunt Elements

NO	wC*Sbase
BUS 5	-40.000
BUS 17	.000
BUS 34	14.000
BUS 37	-25.000
BUS 44	10.000
BUS 45	10.000
BUS 46	10.000
BUS 48	15.000
BUS 74	12.000
BUS 79	20.000
BUS 82	20.000
BUS 83	10.000
BUS 105	20.000
BUS 107	6.000
BUS 110	6.000

```
  Time for input:  1.18
  Time for compact:   .07
  Time for factorization:   .07
. of iterations:  9
ximum mismatch (in pu):  5.6E-04 7.7E-04
  Time for solution:   .10
ecution time:  1.42

base : 100.
```

Bus	Vsp	Voltage		Generation		QGmin	QGmax	Load	
69		1.035	30.00	513.52	-82.38				
1	.955	.955	10.95	.00	-3.10	-5.00	15.00	51.00	27.00
4	.998	.998	15.56	-9.00	-15.01	-300.00	300.00	30.00	12.00
6	.990	.990	13.27	.00	15.93	-13.00	50.00	52.00	22.00
8	1.015	1.015	21.02	-28.00	62.75	-300.00	300.00	.00	.00
10	1.050	1.050	35.86	450.00	-51.04	-147.00	200.00	.00	.00
12	.990	.990	12.47	85.00	91.27	-35.00	120.00	47.00	10.00
15	.970	.970	11.46	.00	3.19	-10.00	30.00	90.00	30.00
18	.973	.973	11.76	.00	25.36	-16.00	50.00	60.00	34.00
19	.962	.963+	11.28	.00	-8.00	-8.00	24.00	45.00	25.00
24	.992	.992	21.06	-13.00	-13.76	-300.00	300.00	.00	.00
25	1.050	1.050	28.15	220.00	49.79	-47.00	140.00	.00	.00
26	1.015	1.015	29.93	314.00	9.89	-1000.00	1000.00	.00	.00
27	.968	.968	15.58	-9.00	2.82	-300.00	300.00	62.00	13.00
31	.967	.967	12.98	7.00	31.97	-300.00	300.00	43.00	27.00
32	.963	.964+	15.02	.00	-14.00	-14.00	42.00	59.00	23.00
34	.984	.986+	11.49	.00	-8.00	-8.00	24.00	59.00	26.00
36	.980	.980	11.06	.00	-1.23	-8.00	24.00	31.00	17.00
40	.970	.970	7.51	-46.00	26.89	-300.00	300.00	20.00	23.00
42	.985	.985	8.66	-59.00	41.00	-300.00	300.00	37.00	23.00
46	1.005	1.005	18.57	19.00	-5.22	-100.00	100.00	28.00	10.00
49	1.025	1.025	21.02	204.00	115.75	-85.00	210.00	87.00	30.00
54	.955	.955	15.35	48.00	4.68	-300.00	300.00	113.00	32.00
55	.952	.952	15.06	.00	4.66	-8.00	23.00	63.00	22.00
56	.954	.954	15.24	.00	-2.23	-8.00	15.00	84.00	18.00
59	.985	.985	19.45	155.00	76.83	-60.00	180.00	277.00	113.00
61	.995	.995	24.12	160.00	-40.39	-100.00	300.00	.00	.00
62	.998	.998	23.50	.00	1.16	-20.00	20.00	77.00	14.00
65	1.005	1.005	27.72	391.00	80.86	-67.00	200.00	.00	.00
66	1.050	1.050	27.56	392.00	-2.06	-67.00	200.00	39.00	18.00
70	.984	.984	22.63	.00	8.14	-10.00	32.00	66.00	20.00
72	.980	.980	21.09	-12.00	-11.12	-100.00	100.00	.00	.00
73	.991	.991	22.00	-6.00	9.65	-100.00	100.00	.00	.00
74	.958	.958	21.68	.00	-5.64	-6.00	9.00	68.00	27.00
76	.943	.943	21.81	.00	5.26	-8.00	23.00	68.00	36.00
77	1.006	1.006	26.76	.00	11.87	-20.00	70.00	61.00	28.00
80	1.040	1.040	29.00	477.00	105.00	-165.00	280.00	130.00	26.00
85	.985	.985	32.55	.00	-5.81	-8.00	23.00	24.00	15.00
87	1.015	1.015	31.44	4.00	11.02	-100.00	1000.00	.00	.00
89	1.005	1.005	39.74	607.00	-12.55	-210.00	300.00	.00	.00
90	.985	.985	33.33	-85.00	59.30	-300.00	300.00	78.00	42.00
91	.980	.980	33.35	-10.00	-15.07	-100.00	100.00	.00	.00
92	.990	.993+	33.85	.00	-3.00	-3.00	9.00	65.00	10.00
99	1.010	1.010	27.08	-42.00	-17.54	-100.00	100.00	.00	.00
100	1.017	1.017	28.08	252.00	108.08	-50.00	155.00	37.00	18.00

103	1.010	1.001-	24.48	40.00	40.00	-15.00	40.00	23.00	16.00
104	.971	.971	21.74	.00	5.60	-8.00	23.00	38.00	25.00
105	.965	.966+	20.62	.00	-8.00	-8.00	23.00	31.00	26.00
107	.952	.952	17.58	-22.00	5.70	-200.00	200.00	28.00	12.00
110	.973	.973	18.14	.00	4.81	-8.00	23.00	39.00	30.00
111	.980	.980	19.78	36.00	-1.84	-100.00	1000.00	.00	.00
112	.975	.975	15.04	-43.00	41.51	-100.00	1000.00	25.00	13.00
113	.993	.993	13.97	-6.00	6.31	-100.00	200.00	.00	.00
116	1.005	1.005	27.16	-184.00	51.32	-1000.00	1000.00	.00	.00

Bus	Voltage		Load	
5 2	.971	11.49	20.00	9.00
5 3	.968	11.84	39.00	10.00
5 5	1.002	16.00	.00	.00
5 7	.989	12.83	19.00	2.00
5 9	1.043	28.28	.00	.00
5 11	.985	12.99	70.00	23.00
5 13	.968	11.61	34.00	16.00
5 14	.984	11.75	14.00	1.00
5 16	.984	12.17	25.00	10.00
5 17	.995	13.98	11.00	3.00
5 20	.958	12.16	18.00	3.00
21	.959	13.74	14.00	8.00
22	.970	16.29	10.00	5.00
23	1.000	21.21	7.00	3.00
28	.962	13.85	17.00	7.00
29	.963	12.86	24.00	4.00
30	.986	19.01	.00	.00
33	.972	10.84	23.00	9.00
35	.981	11.06	33.00	9.00
37	.992	11.95	.00	.00
38	.962	17.09	.00	.00
39	.970	8.58	27.00	11.00
41	.967	7.07	37.00	10.00
43	.978	11.44	18.00	7.00
44	.985	13.93	16.00	8.00
45	.987	15.77	53.00	22.00
47	1.017	20.80	34.00	.00
48	1.021	20.02	20.00	11.00
50	1.001	18.98	17.00	4.00
51	.967	16.36	17.00	8.00
52	.957	15.41	18.00	5.00
53	.946	14.44	23.00	11.00
57	.971	16.45	12.00	3.00
58	.959	15.59	12.00	3.00
60	.993	23.23	78.00	3.00
63	.969	22.82	.00	.00
64	.984	24.59	.00	.00
67	1.020	24.92	28.00	7.00
68	1.003	27.60	.00	.00
71	.987	22.21	.00	.00
75	.967	22.94	47.00	11.00
78	1.003	26.45	71.00	26.00
79	1.009	26.75	39.00	32.00
B1	.997	28.15	.00	.00
B2	.989	27.28	54.00	27.00
B3	.985	28.47	20.00	10.00
B4	.980	31.00	11.00	7.00
B6	.987	31.18	21.00	10.00
B8	.987	35.68	48.00	10.00
93	.987	30.84	12.00	7.00
94	.991	28.69	30.00	16.00
95	.981	27.72	42.00	31.00
96	.993	27.55	38.00	15.00
97	1.011	27.92	15.00	9.00
98	1.024	27.45	34.00	8.00
101	.993	29.65	22.00	15.00

S 102	.991	32.35	5.00	3.00
S 106	.962	20.37	43.00	16.00
S 108	.967	19.43	2.00	1.00
S 109	.967	18.98	8.00	3.00
S 114	.960	14.69	8.00	3.00
S 115	.960	14.68	22.00	7.00
S 117	.974	10.93	20.00	8.00
S 118	.949	21.95	33.00	15.00

ver Generated:	3800.52	791.41
ver Demanded:	3668.00	1438.00
stem Losses:	132.52	-646.59

ntout time: .57

BUS 69	BUS 47	58.69	-10.07
BUS 69	BUS 49	48.78	-12.06
BUS 69	BUS 70	108.20	16.09
BUS 69	BUS 75	109.91	20.50
BUS 69	BUS 77	62.11	6.80
BUS 69	BUS 68	125.84	-103.64
	Total:	513.52	-82.38

BUS 1	BUS 2	-12.36	-13.04
BUS 1	BUS 3	-38.64	-17.06
	Total:	-51.00	-30.10

BUS 4	BUS 5	-103.21	-26.79
BUS 4	BUS 11	64.21	-.21
	Total:	-39.00	-27.01

BUS 6	BUS 5	-87.53	-1.30
BUS 6	BUS 7	35.53	-4.77
	Total:	-52.00	-6.07

BUS 8	BUS 9	-440.64	-89.73
BUS 8	BUS 30	74.21	27.76
BUS 8	BUS 5	338.42	124.72
	Total:	-28.00	62.75

BUS 10	BUS 9	450.00	-51.04
	Total:	450.00	-51.04

BUS 12	BUS 11	-34.14	35.13
BUS 12	BUS 2	32.74	19.42
BUS 12	BUS 3	9.90	8.86
BUS 12	BUS 7	-16.44	5.75
BUS 12	BUS 14	18.28	2.63
BUS 12	BUS 16	7.51	4.29
BUS 12	BUS 117	20.15	5.20
	Total:	38.00	81.27

BUS 15	BUS 13	-.74	-2.05
BUS 15	BUS 14	-4.18	-7.84
BUS 15	BUS 17	-103.66	-24.44
BUS 15	BUS 19	11.40	12.39
BUS 15	BUS 33	7.19	-4.87
	Total:	-90.00	-26.81

BUS 18	BUS 17	-79.42	-22.48
BUS 18	BUS 19	19.42	13.84
Total:		-60.00	-8.64
BUS 19	BUS 18	-19.35	-14.61
BUS 19	BUS 20	-10.59	5.39
BUS 19	BUS 15	-11.36	-13.21
BUS 19	BUS 34	-3.70	-10.57
Total:		-45.00	-33.00
BUS 24	BUS 23	-8.58	-15.53
BUS 24	BUS 70	-5.64	-1.60
BUS 24	BUS 72	1.22	3.37
Total:		-13.00	-13.76
BUS 25	BUS 23	166.97	38.37
BUS 25	BUS 27	143.48	30.06
BUS 25	BUS 26	-90.45	-18.63
Total:		220.00	49.79
BUS 26	BUS 30	223.56	-11.70
BUS 26	BUS 25	90.45	21.59
Total:		314.00	9.89
BUS 27	BUS 25	-137.08	-15.27
BUS 27	BUS 28	32.84	-.59
BUS 27	BUS 32	12.50	1.01
BUS 27	BUS 115	20.74	4.66
Total:		-71.00	-10.18
BUS 31	BUS 17	-14.63	-14.74
BUS 31	BUS 29	8.46	7.91
BUS 31	BUS 32	-29.83	11.80
Total:		-36.00	4.97
BUS 32	BUS 23	-90.12	-5.95
BUS 32	BUS 31	30.17	-13.02
BUS 32	BUS 27	-12.46	-2.68
BUS 32	BUS 113	4.06	-17.51
BUS 32	BUS 114	9.36	2.17
Total:		-59.00	-37.00
BUS 34	BUS 19	3.76	4.76

BUS 34	BUS 36	30.42	11.48
BUS 34	BUS 37	-94.59	-38.57
BUS 34	BUS 43	1.40	1.93
BUS 34	BUS 34	.00	-13.61
Total:		-59.00	-34.00

BUS 36	BUS 35	-.67	-6.49
BUS 36	BUS 34	-30.33	-11.74
Total:		-31.00	-18.23

BUS 40	BUS 37	-42.91	2.20
BUS 40	BUS 39	-26.80	6.97
BUS 40	BUS 41	15.53	1.17
BUS 40	BUS 42	-11.83	-6.45
Total:		-66.00	3.89

BUS 42	BUS 40	11.92	2.30
BUS 42	BUS 41	21.73	5.25
BUS 42	BUS 49	-64.83	5.22
BUS 42	BUS 49	-64.83	5.22
Total:		-96.00	18.00

BUS 46	BUS 45	36.88	1.93
BUS 46	BUS 47	-31.12	-1.22
BUS 46	BUS 48	-14.76	-5.83
BUS 46	BUS 46	.00	-10.10
Total:		-9.00	-15.22

BUS 49	BUS 47	9.57	9.28
BUS 49	BUS 42	67.99	.37
BUS 49	BUS 42	67.99	.37
BUS 49	BUS 45	51.44	2.17
BUS 49	BUS 48	35.11	-3.93
BUS 49	BUS 50	53.67	13.43
BUS 49	BUS 51	66.63	20.52
BUS 49	BUS 54	37.77	13.07
BUS 49	BUS 54	37.75	11.20
BUS 49	BUS 66	-132.19	4.32
BUS 49	BUS 66	-132.19	4.32
BUS 49	BUS 69	-46.54	10.65
Total:		117.00	85.75

BUS 54	BUS 53	12.73	3.77
BUS 54	BUS 49	-36.58	-15.60
BUS 54	BUS 49	-36.38	-13.79
BUS 54	BUS 55	7.08	1.46
BUS 54	BUS 56	18.54	4.34
BUS 54	BUS 59	-30.38	-7.51

	Total:	-65.00	-27.32
BUS 55	BUS 54	-7.07	-3.25
BUS 55	BUS 56	-21.42	-5.82
BUS 55	BUS 59	-34.51	-8.26
	Total:	-63.00	-17.34
BUS 56	BUS 54	-18.53	-4.97
BUS 56	BUS 55	21.45	5.56
BUS 56	BUS 57	-22.99	-9.10
BUS 56	BUS 58	-6.66	-3.63
BUS 56	BUS 59	-27.96	-4.18
BUS 56	BUS 59	-29.31	-3.91
	Total:	-84.00	-20.23
BUS 59	BUS 54	30.90	4.26
BUS 59	BUS 56	28.67	.99
BUS 59	BUS 56	30.07	1.13
BUS 59	BUS 55	35.15	5.88
BUS 59	BUS 60	-43.31	3.57
BUS 59	BUS 61	-51.72	5.03
BUS 59	BUS 63	-151.76	-57.03
	Total:	-122.00	-36.17
BUS 61	BUS 59	52.64	-4.63
BUS 61	BUS 60	112.40	-8.23
BUS 61	BUS 62	25.49	-13.86
BUS 61	BUS 64	-30.52	-13.69
	Total:	160.00	-40.39
BUS 62	BUS 60	9.89	5.74
BUS 62	BUS 61	-25.42	13.20
BUS 62	BUS 66	-37.17	-17.36
BUS 62	BUS 67	-24.31	-14.41
	Total:	-77.00	-12.84
BUS 65	BUS 38	184.86	-9.04
BUS 65	BUS 64	183.76	40.06
BUS 65	BUS 68	13.91	-22.41
BUS 65	BUS 66	8.48	72.25
	Total:	391.00	80.86
BUS 66	BUS 49	135.19	8.33
BUS 66	BUS 49	135.19	8.33
BUS 66	BUS 62	37.93	14.56
BUS 66	BUS 67	53.16	19.27

BUS 66	BUS 65	-8.48	-70.55
Total:		353.00	-20.06
BUS 70	BUS 69	-104.77	-14.05
BUS 70	BUS 24	5.69	-8.17
BUS 70	BUS 71	16.90	-12.44
BUS 70	BUS 74	16.26	12.88
BUS 70	BUS 75	-.07	9.92
Total:		-66.00	-11.86
BUS 72	BUS 24	-1.20	-8.04
BUS 72	BUS 71	-10.80	-3.08
Total:		-12.00	-11.12
BUS 73	BUS 71	-6.00	9.65
Total:		-6.00	9.65
BUS 74	BUS 70	-16.06	-15.41
BUS 74	BUS 75	-51.94	-6.22
BUS 74	BUS 74	.00	-11.01
Total:		-68.00	-32.64
BUS 76	BUS 77	-61.14	-21.04
BUS 76	BUS 118	-6.86	-9.69
Total:		-68.00	-30.74
BUS 77	BUS 76	63.20	24.39
BUS 77	BUS 69	-60.95	-13.85
BUS 77	BUS 75	35.40	7.36
BUS 77	BUS 78	45.39	6.61
BUS 77	BUS 80	-96.58	-37.41
BUS 77	BUS 80	-44.37	-20.54
BUS 77	BUS 82	-3.08	17.30
Total:		-61.00	-16.13
BUS 80	BUS 77	98.36	37.53
BUS 80	BUS 77	45.05	20.59
BUS 80	BUS 79	65.51	31.08
BUS 80	BUS 96	18.92	20.82
BUS 80	BUS 97	26.38	25.51
BUS 80	BUS 98	28.86	8.33
BUS 80	BUS 99	19.47	8.18
BUS 80	BUS 81	44.44	-73.05
Total:		347.00	79.00

BUS 85	BUS 83	43.59	-12.38
BUS 85	BUS 84	36.73	-9.30
BUS 85	BUS 86	17.17	-7.35
BUS 85	BUS 88	-50.32	7.58
BUS 85	BUS 89	-71.17	.66
Total:		-24.00	-20.81

BUS 87	BUS 86	4.00	11.02
Total:		4.00	11.02

BUS 89	BUS 85	72.42	3.73
BUS 89	BUS 88	100.26	7.70
BUS 89	BUS 90	58.17	-4.72
BUS 89	BUS 90	110.73	-5.43
BUS 89	BUS 92	201.82	-7.19
BUS 89	BUS 92	63.60	-6.68
Total:		607.00	-12.58

3US 90	BUS 89	-56.43	5.79
3US 90	BUS 89	-107.84	7.04
3US 90	BUS 91	1.27	4.47
Total:		-163.00	17.30

3US 91	BUS 90	-1.27	-6.50
3US 91	BUS 92	-8.74	-8.57
Total:		-10.00	-15.08

US 92	BUS 89	-197.83	22.10
US 92	BUS 89	-62.02	8.91
US 92	BUS 91	8.79	5.56
US 92	BUS 93	57.72	-10.63
US 92	BUS 94	52.27	-14.19
US 92	BUS 100	31.45	-17.20
US 92	BUS 102	44.62	-7.56
Total:		-65.00	-13.00

US 99	BUS 80	-19.26	-12.96
US 99	BUS 100	-22.74	-4.57
Total:		-42.00	-17.54

JS 100	BUS 92	-30.68	12.90
JS 100	BUS 94	-3.87	44.33
JS 100	BUS 98	5.37	-7.31
JS 100	BUS 99	22.83	2.78
JS 100	BUS 101	-16.74	21.97

BUS 100	BUS 103	121.08	-4.33
BUS 100	BUS 104	56.42	10.57
BUS 100	BUS 106	60.57	9.17
Total:		214.98	90.07
BUS 103	BUS 100	-118.82	6.31
BUS 103	BUS 104	32.31	7.94
BUS 103	BUS 105	42.95	6.56
BUS 103	BUS 110	60.56	3.19
Total:		17.00	24.00
BUS 104	BUS 100	-54.95	-9.38
BUS 104	BUS 103	-31.78	-10.09
BUS 104	BUS 105	48.73	.06
Total:		-38.00	-19.41
BUS 105	BUS 103	-41.92	-7.39
BUS 105	BUS 104	-48.48	-.04
BUS 105	BUS 106	8.68	4.55
BUS 105	BUS 107	26.73	-1.85
BUS 105	BUS 108	23.99	-10.61
BUS 105	BUS 105	.00	-18.66
Total:		-31.00	-34.00
BUS 107	BUS 105	-26.33	-1.09
BUS 107	BUS 106	-23.67	.22
BUS 107	BUS 107	.00	-5.44
Total:		-50.00	-6.30
BUS 110	BUS 103	-59.11	-1.08
BUS 110	BUS 109	-13.64	11.23
BUS 110	BUS 111	-35.70	.96
BUS 110	BUS 112	69.46	-30.61
BUS 110	BUS 110	.00	-5.68
Total:		-39.00	-25.19
BUS 111	BUS 110	36.00	-1.84
Total:		36.00	-1.84
BUS 112	BUS 110	-68.00	28.51
Total:		-68.00	28.51
BUS 113	BUS 17	-2.11	-6.78
BUS 113	BUS 32	-3.89	13.09

	Total:	-6.00	6.31
BUS 116	BUS 68	-184.00	51.32
	Total:	-184.00	51.32
BUS 2	BUS 1	12.45	11.01
BUS 2	BUS 12	-32.45	-20.01
	Total:	-20.00	-9.00
BUS 3	BUS 1	38.89	16.89
BUS 3	BUS 5	-68.10	-14.49
BUS 3	BUS 12	-9.79	-12.39
	Total:	-39.00	-10.00
BUS 5	BUS 4	103.42	27.49
BUS 5	BUS 3	69.34	17.28
BUS 5	BUS 6	88.46	4.11
BUS 5	BUS 11	77.21	2.97
BUS 5	BUS 8	-338.42	-92.01
BUS 5	BUS 5	.00	40.16
	Total:	.00	.00
BUS 7	BUS 6	-35.47	4.50
BUS 7	BUS 12	16.47	-6.50
	Total:	-19.00	-2.00
BUS 9	BUS 8	445.26	24.43
BUS 9	BUS 10	-445.26	-24.43
	Total:	.00	.00
BUS 11	BUS 4	-63.35	1.34
BUS 11	BUS 5	-76.00	-.63
BUS 11	BUS 12	34.29	-35.13
BUS 11	BUS 13	35.06	11.41
	Total:	-70.00	-23.00
BUS 13	BUS 11	-34.74	-12.16
BUS 13	BUS 15	.74	-3.84
	Total:	-34.00	-16.00
BUS 14	BUS 12	-18.21	-4.15
BUS 14	BUS 15	4.21	3.15

	Total:	-14.00	-1.00
BUS 16	BUS 12	-7.49	-6.30
BUS 16	BUS 17	-17.51	-3.70
	Total:	-25.00	-10.00
BUS 17	BUS 15	105.24	25.37
BUS 17	BUS 16	17.65	-.29
BUS 17	BUS 18	80.30	24.85
BUS 17	BUS 31	14.83	11.53
BUS 17	BUS 113	2.11	6.03
BUS 17	BUS 30	-231.13	-70.50
BUS 17	BUS 17	.00	.00
	Total:	-11.00	-3.00
BUS 20	BUS 19	10.63	-7.94
BUS 20	BUS 21	-28.63	4.94
	Total:	-18.00	-3.00
BUS 21	BUS 20	28.80	-6.13
BUS 21	BUS 22	-42.80	-1.87
	Total:	-14.00	-8.00
BUS 22	BUS 21	43.22	1.51
BUS 22	BUS 23	-53.22	-6.51
	Total:	-10.00	-5.00
BUS 23	BUS 22	54.26	7.42
BUS 23	BUS 24	8.61	10.72
BUS 23	BUS 25	-162.76	-25.87
BUS 23	BUS 32	92.89	4.73
	Total:	-7.00	-3.00
BUS 28	BUS 27	-32.62	-.44
BUS 28	BUS 29	15.62	-6.56
	Total:	-17.00	-7.00
BUS 29	BUS 28	-15.55	4.63
BUS 29	BUS 31	-8.45	-8.63
	Total:	-24.00	-4.00
BUS 30	BUS 8	-73.86	-75.07

BUS 30	BUS 26	-219.59	-36.42
BUS 30	BUS 38	62.31	18.11
BUS 30	BUS 17	231.13	93.38
Total:		.00	.00

BUS 33	BUS 15	-7.16	1.94
BUS 33	BUS 37	-15.84	-10.94
Total:		-23.00	-9.00

BUS 35	BUS 36	.67	6.24
BUS 35	BUS 37	-33.67	-15.24
Total:		-33.00	-9.00

BUS 37	BUS 35	33.83	14.65
BUS 37	BUS 33	15.98	7.92
BUS 37	BUS 34	94.86	38.61
BUS 37	BUS 39	54.94	3.75
BUS 37	BUS 40	44.08	-2.93
BUS 37	BUS 38	-243.69	-86.61
BUS 37	BUS 37	.00	24.60
Total:		.00	.00

BUS 38	BUS 30	-62.05	-55.15
BUS 38	BUS 65	-181.64	-56.95
BUS 38	BUS 37	243.69	112.10
Total:		.00	.00

BUS 39	BUS 37	-53.95	-3.07
BUS 39	BUS 40	26.95	-7.93
Total:		-27.00	-11.00

BUS 41	BUS 40	-15.49	-2.20
BUS 41	BUS 42	-21.51	-7.80
Total:		-37.00	-10.00

BUS 43	BUS 44	-16.61	-1.02
BUS 43	BUS 34	-1.39	-5.98
Total:		-18.00	-7.00

BUS 44	BUS 43	16.78	-4.11
BUS 44	BUS 45	-32.78	5.81
BUS 44	BUS 44	.00	-9.70
Total:		-16.00	-8.00

BUS 45	BUS 44	33.04	-6.95
BUS 45	BUS 46	-36.34	-3.37
BUS 45	BUS 49	-49.71	-1.94
BUS 45	BUS 45	.00	-9.73
Total:		-53.00	-22.00

BUS 47	BUS 46	31.48	-.80
BUS 47	BUS 49	-9.54	-10.84
BUS 47	BUS 69	-55.94	11.63
Total:		-34.00	.00

BUS 48	BUS 46	14.90	1.42
BUS 48	BUS 49	-34.90	3.21
BUS 48	BUS 48	.00	-15.63
Total:		-20.00	-11.00

BUS 50	BUS 49	-52.88	-13.14
BUS 50	BUS 57	35.88	9.14
Total:		-17.00	-4.00

BUS 51	BUS 49	-64.35	-17.47
BUS 51	BUS 52	28.57	6.38
BUS 51	BUS 58	18.78	3.10
Total:		-17.00	-8.00

BUS 52	BUS 51	-28.38	-7.12
BUS 52	BUS 53	10.38	2.12
Total:		-18.00	-5.00

BUS 53	BUS 52	-10.32	-5.58
BUS 53	BUS 54	-12.68	-5.42
Total:		-23.00	-11.00

BUS 57	BUS 56	23.22	7.49
BUS 57	BUS 50	-35.22	-10.49
Total:		-12.00	-3.00

BUS 58	BUS 56	6.68	1.47
BUS 58	BUS 51	-18.68	-4.47
Total:		-12.00	-3.00

BUS 60	BUS 59	43.94	-4.40
BUS 60	BUS 61	-112.06	8.52
BUS 60	BUS 62	-9.87	-7.11
Total:		-78.00	-3.00
BUS 63	BUS 64	-151.76	-67.48
BUS 63	BUS 59	151.76	67.48
Total:		.00	.00
BUS 64	BUS 63	152.24	52.51
BUS 64	BUS 65	-182.76	-66.49
BUS 64	BUS 61	30.52	13.99
Total:		.00	.00
3US 67	BUS 62	24.50	12.15
3US 67	BUS 66	-52.50	-19.15
Total:		-28.00	-7.00
3US 68	BUS 65	-13.90	-41.87
3US 68	BUS 81	-44.38	-4.60
3US 68	BUS 116	184.13	-66.35
3US 68	BUS 69	-125.84	112.82
Total:		.00	.00
US 71	BUS 70	-16.86	11.74
US 71	BUS 72	10.85	-1.00
US 71	BUS 73	6.01	-10.74
Total:		.00	.00
US 75	BUS 70	.13	-13.15
US 75	BUS 69	-105.06	-18.35
US 75	BUS 74	52.31	6.47
US 75	BUS 77	-34.60	-9.57
US 75	BUS 118	40.22	23.59
Total:		-47.00	-11.00
JS 78	BUS 77	-45.31	-7.63
JS 78	BUS 79	-25.69	-18.37
Total:		-71.00	-26.00
JS 79	BUS 78	25.74	17.95
JS 79	BUS 80	-64.74	-29.58
JS 79	BUS 79	.00	-20.37

	Total:	-39.00	-32.00
BUS 81	BUS 68	44.44	-75.55
BUS 81	BUS 80	-44.44	75.55
	Total:	.00	.00
BUS 82	BUS 77	3.22	-25.04
BUS 82	BUS 83	-47.09	24.51
BUS 82	BUS 96	-10.13	-6.91
BUS 82	BUS 82	.00	-19.55
	Total:	-54.00	-27.00
BUS 83	BUS 82	47.42	-27.12
BUS 83	BUS 84	-24.72	14.73
BUS 83	BUS 85	-42.70	12.08
BUS 83	BUS 83	.00	-9.69
	Total:	-20.00	-10.00
3US 84	BUS 83	25.28	-16.05
3US 84	BUS 85	-36.28	9.05
	Total:	-11.00	-7.00
3US 86	BUS 85	-17.05	5.09
3US 86	BUS 87	-3.95	-15.09
	Total:	-21.00	-10.00
US 88	BUS 85	50.86	-7.52
US 88	BUS 89	-98.86	-2.48
	Total:	-48.00	-10.00
US 93	BUS 92	-56.83	11.44
US 93	BUS 94	44.84	-18.45
	Total:	-11.99	-7.01
JS 94	BUS 92	-50.86	14.82
JS 94	BUS 93	-44.31	18.36
JS 94	BUS 95	40.99	9.38
JS 94	BUS 96	19.93	-9.41
JS 94	BUS 100	4.26	-49.14
	Total:	-30.00	-16.01
JS 95	BUS 94	-40.75	-9.67

BUS 95	BUS 96	-1.25	-21.33
Total:		-42.00	-31.00
BUS 96	BUS 80	-18.62	-24.40
BUS 96	BUS 82	10.15	1.64
BUS 96	BUS 94	-19.80	7.56
BUS 96	BUS 95	1.33	20.14
BUS 96	BUS 97	-11.06	-19.94
Total:		-38.00	-15.00
BUS 97	BUS 80	-26.14	-26.96
BUS 97	BUS 96	11.14	17.96
Total:		-15.00	-9.00
BUS 98	BUS 80	-28.65	-10.45
BUS 98	BUS 100	-5.35	2.45
Total:		-34.00	-8.00
BUS 101	BUS 100	16.96	-24.26
BUS 101	BUS 102	-38.97	9.26
Total:		-22.00	-15.00
BUS 102	BUS 92	-44.36	7.27
BUS 102	BUS 101	39.37	-10.29
Total:		-4.99	-3.02
BUS 106	BUS 100	-58.34	-6.78
BUS 106	BUS 105	-8.66	-5.82
BUS 106	BUS 107	24.00	-3.40
Total:		-43.00	-16.00
BUS 108	BUS 105	-23.80	9.39
BUS 108	BUS 109	21.81	-10.39
Total:		-2.00	-1.00
BUS 109	BUS 108	-21.74	9.86
BUS 109	BUS 110	13.74	-12.86
Total:		-8.00	-3.00
BUS 114	BUS 32	-9.34	-3.61
BUS 114	BUS 115	1.34	.61
Total:		-8.00	-3.00

BUS 115	BUS 27	-20.66	-6.13
BUS 115	BUS 114	-1.34	-.87
Total:		-22.00	-7.00
BUS 117	BUS 12	-20.00	-8.00
Total:		-20.00	-8.00
BUS 118	BUS 75	-39.88	-23.56
BUS 118	BUS 76	6.88	8.56
Total:		-33.00	-15.00
System losses:		132.52	-646.68
R*I**2,X*I**2:		132.52	781.31

Appendix E

IEEE 14 Bus Network

FDLF Based Results

E.1. Transmission line data
Transformer data
Shunt element data

E.2. Bus oriented results

E.3. Line flow results

Sbase: 100.

Transmission Lines

NO	NE	R %	X %	X/R	wC*Sbase	Length
BUS 1	BUS 2	1.938	5.917	3.05	5.280	29.8
BUS 1	BUS 5	5.403	22.304	4.13	4.920	94.4
BUS 2	BUS 3	4.699	19.797	4.21	4.380	82.8
BUS 2	BUS 4	5.811	17.632	3.03	3.740	89.2
BUS 2	BUS 5	5.695	17.388	3.05	3.400	87.6
BUS 3	BUS 4	6.701	17.103	2.55	3.460	96.6
BUS 4	BUS 5	1.335	4.211	3.15	1.280	20.8
BUS 6	BUS 11	9.498	19.890	2.09		12.4
BUS 6	BUS 12	12.291	25.581	2.08		16.1
BUS 6	BUS 13	6.615	13.027	1.97		8.4
BUS 7	BUS 8	.000	17.615			
BUS 7	BUS 9	.000	11.001			
BUS 9	BUS 10	3.181	8.450	2.66		46.5
BUS 9	BUS 14	12.711	27.038	2.13		16.8
BUS 10	BUS 11	8.205	19.207	2.34		11.4
BUS 12	BUS 13	22.092	19.988	.90		20.5
BUS 13	BUS 14	17.093	34.802	2.04		22.1

Transformers

NO	NE	R %	X %	Tap
BUS 4	BUS 7	.000	20.912	.978
BUS 4	BUS 9	.000	55.618	.969
BUS 5	BUS 6	.000	25.202	.932

Shunt Elements

NO	wC*Sbase
BUS 9	19.000

Time for input: .09
Time for compact: .01
Time for factorization: .00
of iterations: 4
imum mismatch (in pu): 8.4E-04 1.3E-04
Time for solution: .01
cution time: .10

ase : 100.

Bus	Vsp	Voltage		Generation		QGmin	QGmax	Load	
1		1.060	.00	232.38	-16.89				
2	1.045	1.045	-4.98	40.00	42.39	-40.00	50.00	21.70	12.70
3	1.010	1.010	-12.72	.00	23.39	.00	40.00	94.20	19.00
6	1.070	1.070	-14.22	.00	12.24	-6.00	24.00	11.20	7.50
8	1.090	1.090	-13.37	.00	17.36	-6.00	24.00	.00	.00

us	Voltage		Load	
4	1.019	-10.32	47.80	-3.90
5	1.020	-8.78	7.60	1.60
7	1.062	-13.37	.00	.00
9	1.056	-14.95	29.50	16.60
10	1.051	-15.10	9.00	5.80
11	1.057	-14.80	3.50	1.80
12	1.055	-15.08	6.10	1.60
13	1.050	-15.16	13.50	5.80
14	1.036	-16.04	14.90	5.00

r Generated:	272.38	78.50
r Demanded:	259.00	73.50
em Losses:	13.38	5.00

tout time: .07

BUS 1	BUS 2	156.83	-20.39
BUS 1	BUS 5	75.55	3.50
	Total:	232.38	-16.89

BUS 2	BUS 1	-152.53	27.65
BUS 2	BUS 3	73.19	3.57
BUS 2	BUS 4	56.14	-2.29
BUS 2	BUS 5	41.51	.76
	Total:	18.30	29.69

BUS 3	BUS 2	-70.87	1.58
BUS 3	BUS 4	-23.33	2.81
	Total:	-94.20	4.39

BUS 6	BUS 11	7.34	3.47
BUS 6	BUS 12	7.78	2.49
BUS 6	BUS 13	17.74	7.17
BUS 6	BUS 5	-44.06	-8.40
	Total:	-11.20	4.74

BUS 8	BUS 7	.00	17.36
	Total:	.00	17.36

BUS 4	BUS 2	-54.46	3.39
BUS 4	BUS 3	23.70	-5.42
BUS 4	BUS 5	-61.22	15.67
BUS 4	BUS 7	28.09	-9.42
BUS 4	BUS 9	16.09	-.32
	Total:	-47.80	3.90

BUS 5	BUS 1	-72.79	2.58
BUS 5	BUS 2	-40.61	-1.63
BUS 5	BUS 4	61.73	-15.37
BUS 5	BUS 6	44.06	12.82
	Total:	-7.61	-1.60

BUS 7	BUS 8	.00	-16.91
BUS 7	BUS 9	28.09	5.80
BUS 7	BUS 4	-28.09	11.11
	Total:	.00	.00

BUS 9	BUS 7	-28.09	-5.00
BUS 9	BUS 10	5.24	4.31

BUS 14	9.44	3.67
BUS 4	-16.09	1.62
BUS 9	.00	-21.20
Total:	-29.50	-16.60

BUS 9	-5.23	-4.27
BUS 11	-3.77	-1.53
Total:	-9.00	-5.80

BUS 6	-7.29	-3.36
BUS 10	3.79	1.56
Total:	-3.50	-1.80

BUS 6	-7.71	-2.34
BUS 13	1.61	.74
Total:	-6.10	-1.60

BUS 6	-17.53	-6.75
BUS 12	-1.60	-.74
BUS 14	5.63	1.69
Total:	-13.50	-5.80

BUS 9	-9.32	-3.42
BUS 13	-5.58	-1.58
Total:	-14.90	-5.00

losses:	13.39	5.00

Appendix F

250 Bus Network

Updated Line Values

NO	NE	R	X	X/R	wC	wCcomp	wCset	Length
BUS 1	BUS 2	3.030	9.990	3.30	2.540	3.122	2.540	48.0
BUS 1	BUS 3	1.290	4.240	3.29	1.082	1.328	1.082	20.4
BUS 4	BUS 5	.176	.798	4.53	.210	.209	.210	3.2
BUS 3	BUS 5	2.410	10.800	4.48	2.840	2.843	2.840	43.7
BUS 5	BUS 6	1.190	5.400	4.54	1.426	1.412	1.426	21.7
BUS 6	BUS 7	.459	2.080	4.53	.550	.544	.550	8.4
BUS 8	BUS 9	.244	3.050	12.50	116.200	48.536	48.536*	90.5
BUS 9	BUS 10	.258	3.220	12.48	123.000	51.278	51.278*	95.6
BUS 4	BUS 11	2.090	6.880	3.29	1.748	2.152	1.748	33.1
BUS 5	BUS 11	2.030	6.820	3.36	1.738	2.108	1.738	32.4
BUS 11	BUS 12	.595	1.960	3.29	.502	.613	.502	9.4
BUS 2	BUS 12	1.870	6.160	3.29	1.572	1.926	1.572	29.6
BUS 3	BUS 12	4.840	16.000	3.31	4.060	4.993	4.060	76.8
BUS 7	BUS 12	.862	3.400	3.94	.874	.959	.874	14.7
BUS 11	BUS 13	2.225	7.310	3.29	1.876	2.290	1.876	35.2
BUS 12	BUS 14	2.150	7.070	3.29	1.816	2.213	1.816	34.0
BUS 13	BUS 15	7.440	24.440	3.28	6.268	7.656	6.268	117.8
BUS 14	BUS 15	5.950	19.500	3.28	5.020	6.117	5.020	94.1
BUS 12	BUS 16	2.120	8.340	3.93	2.140	2.355	2.140	36.2
BUS 15	BUS 17	1.320	4.370	3.31	4.440	1.363	1.363*	21.0
BUS 16	BUS 17	4.540	18.010	3.97	4.660	5.061	4.660	77.9
BUS 17	BUS 18	1.230	5.050	4.11	1.298	1.393	1.298	21.4
BUS 18	BUS 19	1.190	4.930	4.14	1.142	1.353	1.142	20.8
BUS 19	BUS 20	2.520	11.700	4.64	2.980	3.024	2.980	46.5
BUS 15	BUS 19	1.200	3.940	3.28	1.010	1.235	1.010	19.0
BUS 20	BUS 21	1.830	8.490	4.64	2.160	2.195	2.160	33.8
BUS 21	BUS 22	2.090	9.700	4.64	2.460	2.507	2.460	38.6
BUS 22	BUS 23	3.420	15.900	4.65	4.040	4.107	4.040	63.2
BUS 23	BUS 24	1.350	4.920	3.64	4.980	1.450	1.450*	22.3
BUS 23	BUS 25	1.560	8.000	5.13	8.640	1.967	1.967*	30.3
BUS 25	BUS 27	3.180	16.300	5.13	17.640	4.009	4.009*	61.7
BUS 27	BUS 28	1.913	8.550	4.47	2.160	2.254	2.160	34.7
BUS 28	BUS 29	2.370	9.430	3.98	2.380	2.646	2.380	40.7
BUS 8	BUS 30	.431	5.040	11.69	51.400	82.752	51.400	154.3
BUS 26	BUS 30	.799	8.600	10.76	90.800	147.030	90.800	274.2
BUS 17	BUS 31	4.740	15.630	3.30	3.990	4.885	3.990	75.2
BUS 29	BUS 31	1.080	3.310	3.06	.830	1.081	.830	16.6
BUS 23	BUS 32	3.170	11.530	3.64	11.730	3.402	3.402*	52.3
BUS 31	BUS 32	2.980	9.850	3.31	2.510	3.074	2.510	47.3
BUS 27	BUS 32	2.290	7.550	3.30	1.926	2.360	1.926	36.3
BUS 15	BUS 33	3.800	12.440	3.27	3.194	3.905	3.194	60.1
BUS 19	BUS 34	7.520	24.700	3.28	6.320	7.738	6.320	119.0
BUS 35	BUS 36	.224	1.020	4.55	.268	.266	.268	4.1
BUS 35	BUS 37	1.100	4.970	4.52	1.318	1.303	1.318	20.0
BUS 33	BUS 37	4.150	14.200	3.42	3.660	4.342	3.660	66.8
BUS 34	BUS 36	.871	2.680	3.08	.568	.873	.568	13.4
BUS 34	BUS 37	.256	.940	3.67	.984	.276	.276*	4.2
BUS 37	BUS 39	3.210	10.600	3.30	2.700	3.310	2.700	50.9
BUS 37	BUS 40	5.930	16.800	2.83	4.200	5.764	4.200	88.7
BUS 30	BUS 38	.464	5.400	11.64	42.200	88.865	42.200	165.7
BUS 39	BUS 40	1.840	6.050	3.29	1.552	1.894	1.552	29.1

NO	NE	R	X	X/R	wC	wCcomp	wCset	Length
BUS 40	BUS 41	1.450	4.780	3.30	1.222	1.494	1.222	23.0
BUS 40	BUS 42	5.550	18.300	3.30	4.660	5.720	4.660	88.0
BUS 41	BUS 42	4.100	13.500	3.29	3.440	4.223	3.440	65.0
BUS 43	BUS 44	6.080	24.540	4.04	6.068	6.831	6.068	105.1
BUS 34	BUS 43	4.130	16.810	4.07	4.226	4.658	4.226	71.7
BUS 44	BUS 45	2.240	9.010	4.02	2.240	2.513	2.240	38.7
BUS 45	BUS 46	4.000	13.560	3.39	3.320	4.169	3.320	64.1
BUS 46	BUS 47	3.800	12.700	3.34	3.160	3.937	3.160	60.6
BUS 46	BUS 48	6.010	18.900	3.14	4.720	6.078	4.720	93.5
BUS 47	BUS 49	1.910	6.250	3.27	1.604	1.962	1.604	30.2
BUS 42	BUS 49	7.150	32.300	4.52	8.600	8.467	8.600	130.3
BUS 42	BUS 49	7.150	32.300	4.52	8.600	8.467	8.600	130.3
BUS 45	BUS 49	6.840	18.600	2.72	4.440	6.551	4.440	100.8
BUS 48	BUS 49	1.790	5.050	2.82	1.258	1.737	1.258	26.7
BUS 49	BUS 50	2.670	7.520	2.82	1.874	2.590	1.874	39.8
BUS 49	BUS 51	4.860	13.700	2.82	3.420	4.716	3.420	72.5
BUS 51	BUS 52	2.030	5.880	2.90	1.396	1.990	1.396	30.6
BUS 52	BUS 53	4.050	16.350	4.04	4.060	4.551	4.060	70.0
BUS 53	BUS 54	2.630	12.200	4.64	2.100	3.155	2.100	48.5
BUS 49	BUS 54	7.300	28.900	3.96	7.380	8.131	7.380	125.1
BUS 49	BUS 54	8.690	29.100	3.35	7.300	9.012	7.300	138.6
BUS 54	BUS 55	1.690	7.070	4.18	2.020	1.930	2.020	29.7
BUS 54	BUS 56	.275	.955	3.47	.732	.289	.289*	4.5
BUS 55	BUS 56	.488	1.510	3.09	.374	.490	.374	7.5
BUS 56	BUS 57	3.430	9.660	2.82	2.420	3.327	2.420	51.2
BUS 50	BUS 57	4.740	13.400	2.83	3.320	4.604	3.320	70.8
BUS 56	BUS 58	3.430	9.660	2.82	2.420	3.327	2.420	51.2
BUS 51	BUS 58	2.550	7.190	2.82	1.788	2.475	1.788	38.1
BUS 54	BUS 59	5.030	22.930	4.56	5.980	5.982	5.980	92.0
BUS 56	BUS 59	8.250	25.100	3.04	5.690	8.237	5.690	126.7
BUS 56	BUS 59	8.030	23.900	2.98	5.360	7.951	5.360	122.3
BUS 55	BUS 59	4.739	21.580	4.55	5.646	5.633	5.646	86.7
BUS 59	BUS 60	3.170	14.500	4.57	3.760	3.776	3.760	58.1
BUS 59	BUS 61	3.280	15.000	4.57	3.880	3.907	3.880	60.1
BUS 60	BUS 61	.264	1.350	5.11	1.456	.332	.332*	5.1
BUS 60	BUS 62	1.230	5.610	4.56	1.468	1.463	1.468	22.5
BUS 61	BUS 62	.824	3.760	4.56	.980	.980	.980	15.1
BUS 63	BUS 64	.172	2.000	11.63	21.600	32.927	21.600	61.4
BUS 38	BUS 65	.901	9.860	10.94	104.600	167.190	104.600	311.8
BUS 64	BUS 65	.269	3.020	11.23	38.000	50.570	38.000	94.3
BUS 49	BUS 66	1.800	9.190	5.11	2.480	2.265	2.480	34.8
BUS 49	BUS 66	1.800	9.190	5.11	2.480	2.265	2.480	34.8
BUS 62	BUS 66	4.820	21.800	4.52	5.980	5.711	5.980	87.9
BUS 62	BUS 67	2.580	11.700	4.53	3.100	3.061	3.100	47.1
BUS 66	BUS 67	2.240	10.150	4.53	2.682	2.656	2.682	40.9
BUS 65	BUS 68	.138	1.600	11.59	63.800	26.378	26.378*	49.2
BUS 47	BUS 69	8.440	27.780	3.29	7.092	8.692	7.092	133.7
BUS 49	BUS 69	9.850	32.400	3.29	8.280	10.141	8.280	156.0
BUS 69	BUS 70	3.000	12.700	4.23	12.200	3.445	3.445*	53.0
BUS 24	BUS 70	10.221	41.150	4.03	10.200	11.471	10.200	176.5
BUS 70	BUS 71	.882	3.550	4.02	.880	.990	.880	15.2
BUS 24	BUS 72	4.880	19.600	4.02	4.880	5.471	4.880	84.2

NO	NE	R	X	X/R	wC	wCcomp	wCset	Length
BUS 71	BUS 72	4.460	18.000	4.04	4.444	5.011	4.444	77.1
BUS 71	BUS 73	.866	4.540	5.24	1.180	1.105	1.180	17.0
BUS 70	BUS 74	4.010	13.230	3.30	3.368	4.133	3.368	63.6
BUS 70	BUS 75	4.280	14.100	3.29	3.600	4.409	3.600	67.8
BUS 69	BUS 75	4.050	12.200	3.01	12.400	4.028	4.028*	62.0
BUS 74	BUS 75	1.230	4.060	3.30	1.034	1.268	1.034	19.5
BUS 76	BUS 77	4.440	14.800	3.33	3.680	4.596	3.680	70.7
BUS 69	BUS 77	3.090	10.100	3.27	10.400	3.173	3.173*	48.8
BUS 75	BUS 77	6.010	19.990	3.33	5.000	6.215	5.000	95.6
BUS 77	BUS 78	.376	1.240	3.30	1.264	.388	.388*	6.0
BUS 78	BUS 79	.546	2.440	4.47	.648	.643	.648	9.9
BUS 77	BUS 80	1.700	4.850	2.85	4.720	1.657	1.657*	25.5
BUS 77	BUS 80	2.940	10.500	3.57	2.280	3.131	2.280	48.2
BUS 79	BUS 80	1.560	7.040	4.51	1.870	1.846	1.870	28.4
BUS 68	BUS 81	.175	2.020	11.54	80.800	33.373	33.373*	62.2
BUS 77	BUS 82	2.980	8.530	2.86	8.180	2.908	2.908*	44.7
BUS 82	BUS 83	1.120	3.665	3.27	3.800	1.151	1.151*	17.7
BUS 83	BUS 84	5.180	13.200	2.55	2.600	4.850	2.600	74.6
BUS 83	BUS 85	4.300	14.800	3.44	3.480	4.510	3.480	69.4
BUS 84	BUS 85	2.510	6.410	2.55	1.234	2.352	1.234	36.2
BUS 85	BUS 86	3.500	12.300	3.51	2.760	3.703	2.760	57.0
BUS 86	BUS 87	2.828	20.740	7.33	4.450	35.892	35.892*	201.5
BUS 85	BUS 88	2.000	10.200	5.10	2.760	2.515	2.760	38.7
BUS 85	BUS 89	2.390	17.300	7.24	4.700	30.120	30.120*	169.1
BUS 88	BUS 89	1.390	7.120	5.12	1.934	1.752	1.934	27.0
BUS 89	BUS 90	5.180	18.800	3.63	5.280	5.555	5.280	85.5
BUS 89	BUS 90	2.380	9.970	4.19	10.600	2.720	2.720*	41.8
BUS 90	BUS 91	2.540	8.360	3.29	2.140	2.616	2.140	40.2
BUS 89	BUS 92	.990	5.050	5.10	5.480	1.245	1.245*	19.2
BUS 89	BUS 92	3.930	15.810	4.02	4.140	4.409	4.140	67.8
BUS 91	BUS 92	3.870	12.720	3.29	3.268	3.983	3.268	61.3
BUS 92	BUS 93	2.580	8.480	3.29	2.180	2.655	2.180	40.9
BUS 92	BUS 94	4.810	15.800	3.28	4.060	4.949	4.060	76.1
BUS 93	BUS 94	2.230	7.320	3.28	1.876	2.294	1.876	35.3
BUS 94	BUS 95	1.320	4.340	3.29	1.110	1.359	1.110	20.9
BUS 80	BUS 96	3.560	18.200	5.11	4.940	4.482	4.940	69.0
BUS 82	BUS 96	1.620	5.300	3.27	5.440	1.664	1.664*	25.6
BUS 94	BUS 96	2.690	8.690	3.23	2.300	2.750	2.300	42.3
BUS 80	BUS 97	1.830	9.340	5.10	2.540	2.302	2.540	35.4
BUS 80	BUS 98	2.380	10.800	4.54	2.860	2.824	2.860	43.5
BUS 80	BUS 99	4.540	20.600	4.54	5.460	5.388	5.460	82.9
BUS 92	BUS 100	6.480	29.500	4.55	7.720	7.702	7.720	118.5
BUS 94	BUS 100	1.780	5.800	3.26	6.040	1.826	1.826*	28.1
BUS 95	BUS 96	1.710	5.470	3.20	1.474	1.741	1.474	26.8
BUS 96	BUS 97	1.730	8.850	5.12	2.400	2.179	2.400	33.5
BUS 98	BUS 100	3.970	17.900	4.51	4.760	4.697	4.760	72.3
BUS 99	BUS 100	1.800	8.130	4.52	2.160	2.131	2.160	32.8
BUS 100	BUS 101	2.770	12.620	4.56	3.280	3.294	3.280	50.7
BUS 92	BUS 102	1.230	5.590	4.54	1.464	1.461	1.464	22.5
BUS 101	BUS 102	2.460	11.200	4.55	2.940	2.924	2.940	45.0
BUS 100	BUS 103	1.600	5.250	3.28	5.360	1.646	1.646*	25.3
BUS 100	BUS 104	4.510	20.400	4.52	5.510	5.344	5.510	82.2

NO	NE	R	X	X/R	wC	wCcomp	wCset	Length
BUS 103	BUS 104	4.660	15.840	3.40	4.070	4.862	4.070	74.8
BUS 103	BUS 105	5.350	16.250	3.04	4.080	5.338	4.080	82.1
BUS 100	BUS 106	6.050	22.900	3.79	6.200	6.606	6.200	101.6
BUS 104	BUS 105	.994	3.780	3.80	.986	1.088	.986	16.7
BUS 105	BUS 106	1.400	5.470	3.91	1.434	1.550	1.434	23.9
BUS 105	BUS 107	5.300	18.300	3.45	4.720	5.566	4.720	85.6
BUS 105	BUS 108	2.610	7.030	2.69	1.844	2.491	1.844	38.3
BUS 106	BUS 107	5.300	18.300	3.45	4.720	5.566	4.720	85.6
BUS 108	BUS 109	1.050	2.880	2.74	.760	1.009	.760	15.5
BUS 103	BUS 110	3.906	18.130	4.64	4.710	4.686	4.710	72.1
BUS 109	BUS 110	2.780	7.620	2.74	2.020	2.670	2.020	41.1
BUS 110	BUS 111	2.200	7.550	3.43	2.000	2.304	2.000	35.5
BUS 110	BUS 112	2.470	6.400	2.59	6.200	2.326	2.326*	35.8
BUS 17	BUS 113	.913	3.010	3.30	.768	.941	.768	14.5
BUS 32	BUS 113	6.150	20.300	3.30	5.180	6.341	5.180	97.5
BUS 32	BUS 114	1.350	6.120	4.53	1.626	1.601	1.626	24.6
BUS 27	BUS 115	1.640	7.410	4.52	1.972	1.942	1.972	29.9
BUS 114	BUS 115	.230	1.040	4.52	.276	.272	.276	4.2
BUS 68	BUS 116	.034	.405	11.91	16.400	6.592	6.592*	12.3
BUS 12	BUS 117	3.290	14.000	4.26	3.580	3.787	3.580	58.3
BUS 75	BUS 118	1.450	4.810	3.32	1.200	1.498	1.200	23.0
BUS 76	BUS 118	1.640	5.440	3.32	1.356	1.694	1.356	26.1
1	A 2	1.920	5.750	2.99	2.640	1.906	2.640	29.3
1	A 3	4.520	18.520	4.10	2.040	5.113	2.040	78.7
2	A 4	5.700	17.370	3.05	1.840	5.695	5.695*	87.6
3	A 4	1.320	3.790	2.87	.420	1.289	1.289*	19.8
2	A 5	4.720	19.830	4.20	2.090	5.401	2.090	83.1
2	A 6	5.810	17.630	3.03	1.870	5.795	5.795*	89.2
4	A 6	1.190	4.140	3.48	.450	1.254	.450	19.3
5	A 7	4.600	13.800	3.00	1.020	4.568	4.568*	70.3
6	A 7	2.670	8.200	3.07	.850	2.676	2.676*	41.2
6	A 8	1.200	4.200	3.50	.450	1.267	.450	19.5
6	A 28	1.690	5.990	3.54	.650	1.794	.650	27.6
8	A 28	6.360	20.000	3.14	2.140	6.432	2.140	99.0
9	A 11	.000	20.800					
9	A 10	.000	11.000					
12	A 13	.000	14.000					
12	A 14	12.310	25.590	2.08				16.1
12	A 15	6.620	13.040	1.97				8.4
12	A 16	9.450	19.870	2.10				12.4
14	A 15	9.650	19.970	2.07				12.6
16	A 17	8.240	19.320	2.34				11.5
15	A 18	10.700	21.850	2.04				13.8
18	A 19	6.390	12.920	2.02				8.2
19	A 20	3.400	6.800	2.00				4.4
10	A 20	9.360	20.900	2.23				12.7
10	A 17	3.240	6.800	2.10				4.2
10	A 21	3.480	7.490	2.15				4.6
10	A 22	7.270	14.990	2.06				9.4
21	A 22	1.160	2.360	2.03				1.5
15	A 23	10.000	20.200	2.02				12.9
22	A 24	11.500	17.900	1.56				13.1

NO	NE	R	X	X/R	wC	wCcomp	wCset	Length
A 23	A 24	13.200	27.000	2.05				17.1
A 24	A 25	18.850	32.920	1.75				22.6
A 25	A 26	20.540	38.000	1.85				25.3
A 25	A 27	10.930	20.870	1.91				13.7
A 27	A 29	21.980	41.530	1.89				27.4
A 27	A 30	32.020	60.270	1.88				39.8
A 29	A 30	23.990	45.330	1.89				29.9
A 1	BUS 48	4.600	17.680	3.84	2.140	5.057	2.140	77.8
A 8	BUS 40	1.250	4.620	3.70	.480	1.351	.480	20.8
A 2	BUS 45	2.600	8.100	3.12	.820	2.620	2.620*	40.3
A 28	BUS 42	2.110	6.850	3.25	1.890	2.161	1.890	33.2
A 5	BUS 44	1.900	5.600	2.95	2.600	1.874	2.600	28.8
B 1	B 2	1.920	5.750	2.99	2.640	1.906	2.640	29.3
B 1	B 3	4.520	18.520	4.10	2.040	5.113	2.040	78.7
B 2	B 4	5.700	17.370	3.05	1.840	5.695	5.695*	87.6
B 3	B 4	1.320	3.790	2.87	.420	1.289	1.289*	19.8
B 2	B 5	4.720	19.830	4.20	2.090	5.401	2.090	83.1
B 2	B 6	5.810	17.630	3.03	1.870	5.795	5.795*	89.2
B 4	B 6	1.190	4.140	3.48	.450	1.254	.450	19.3
B 5	B 7	4.600	13.800	3.00	1.020	4.568	4.568*	70.3
6	B 7	2.670	8.200	3.07	.850	2.676	2.676*	41.2
6	B 8	1.200	4.200	3.50	.450	1.267	.450	19.5
6	B 28	1.690	5.990	3.54	.650	1.794	.650	27.6
8	B 28	6.360	20.000	3.14	2.140	6.432	2.140	99.0
9	B 11	.000	20.800					
9	B 10	.000	11.000					
12	B 13	.000	14.000					
12	B 14	12.310	25.590	2.08				16.1
12	B 15	6.620	13.040	1.97				8.4
12	B 16	9.450	19.870	2.10				12.4
14	B 15	9.650	19.970	2.07				12.6
16	B 17	8.240	19.320	2.34				11.5
15	B 18	10.700	21.850	2.04				13.8
18	B 19	6.390	12.920	2.02				8.2
19	B 20	3.400	6.800	2.00				4.4
10	B 20	9.360	20.900	2.23				12.7
10	B 17	3.240	6.800	2.10				4.2
10	B 21	3.480	7.490	2.15				4.6
10	B 22	7.270	14.990	2.06				9.4
21	B 22	1.160	2.360	2.03				1.5
15	B 23	10.000	20.200	2.02				12.9
22	B 24	11.500	17.900	1.56				13.1
23	B 24	13.200	27.000	2.05				17.1
24	B 25	18.850	32.920	1.75				22.6
25	B 26	20.540	38.000	1.85				25.3
25	B 27	10.930	20.870	1.91				13.7
27	B 29	21.980	41.530	1.89				27.4
27	B 30	32.020	60.270	1.88				39.8
29	B 30	23.990	45.330	1.89				29.9
1	BUS 20	1.300	4.800	3.69	.520	1.404	.520	21.6
4	BUS 21	2.500	8.200	3.28	.750	2.571	2.571*	39.6
8	BUS 22	2.300	7.900	3.43	.600	2.410	2.410*	37.1

NO	NE	R	X	X/R	wC	wCcomp	wCset	Length
B 28	BUS 32	4.800	17.800	3.71	2.150	5.195	2.150	79.9
C 1	C 2	1.920	5.750	2.99	2.640	1.906	2.640	29.3
C 1	C 3	4.520	18.520	4.10	2.040	5.113	2.040	78.7
C 2	C 4	5.700	17.370	3.05	1.840	5.695	5.695*	87.6
C 3	C 4	1.320	3.790	2.87	.420	1.289	1.289*	19.8
C 2	C 5	4.720	19.830	4.20	2.090	5.401	2.090	83.1
C 2	C 6	5.810	17.630	3.03	1.870	5.795	5.795*	89.2
C 4	C 6	1.190	4.140	3.48	.450	1.254	.450	19.3
C 5	C 7	4.600	13.800	3.00	1.020	4.568	4.568*	70.3
C 6	C 7	2.670	8.200	3.07	.850	2.676	2.676*	41.2
C 6	C 8	1.200	4.200	3.50	.450	1.267	.450	19.5
C 6	C 28	1.690	5.990	3.54	.650	1.794	.650	27.6
C 8	C 28	6.360	20.000	3.14	2.140	6.432	2.140	99.0
C 9	C 11	.000	20.800					
C 9	C 10	.000	11.000					
C 12	C 13	.000	14.000					
C 12	C 14	12.310	25.590	2.08				16.1
C 12	C 15	6.620	13.040	1.97				8.4
C 12	C 16	9.450	19.870	2.10				12.4
C 14	C 15	9.650	19.970	2.07				12.6
C 16	C 17	8.240	19.320	2.34				11.5
C 15	C 18	10.700	21.850	2.04				13.8
C 18	C 19	6.390	12.920	2.02				8.2
C 19	C 20	3.400	6.800	2.00				4.4
C 10	C 20	9.360	20.900	2.23				12.7
C 10	C 17	3.240	6.800	2.10				4.2
C 10	C 21	3.480	7.490	2.15				4.6
C 10	C 22	7.270	14.990	2.06				9.4
C 21	C 22	1.160	2.360	2.03				1.5
C 15	C 23	10.000	20.200	2.02				12.9
C 22	C 24	11.500	17.900	1.56				13.1
C 23	C 24	13.200	27.000	2.05				17.1
C 24	C 25	18.850	32.920	1.75				22.6
C 25	C 26	20.540	38.000	1.85				25.3
C 25	C 27	10.930	20.870	1.91				13.7
C 27	C 29	21.980	41.530	1.89				27.4
C 27	C 30	32.020	60.270	1.88				39.8
C 29	C 30	23.990	45.330	1.89				29.9
C 28	BUS 82	1.250	4.580	3.66	.450	1.346	.450	20.7
C 8	BUS 83	1.300	4.650	3.58	.520	1.385	.520	21.3
C 5	BUS 85	1.500	4.820	3.21	.550	1.530	.550	23.5
C 2	BUS 89	4.600	17.200	3.74	2.150	4.996	2.150	76.9
C 1	BUS 92	2.000	7.200	3.60	1.160	2.137	1.160	32.9
C 4	BUS 95	1.800	6.200	3.44	.950	1.888	.950	29.1
C 1	D 2	1.920	5.750	2.99	2.640	1.906	2.640	29.3
C 1	D 3	4.520	18.520	4.10	2.040	5.113	2.040	78.7
C 2	D 4	5.700	17.370	3.05	1.840	5.695	5.695*	87.6
C 3	D 4	1.320	3.790	2.87	.420	1.289	1.289*	19.8
C 2	D 5	4.720	19.830	4.20	2.090	5.401	2.090	83.1
C 2	D 6	5.810	17.630	3.03	1.870	5.795	5.795*	89.2
C 4	D 6	1.190	4.140	3.48	.450	1.254	.450	19.3
C 5	D 7	4.600	13.800	3.00	1.020	4.568	4.568*	70.3

NO	NE	R	X	X/R	wC	wCcomp	wCset	Length
D 6	D 7	2.670	8.200	3.07	.850	2.676	2.676*	41.2
D 6	D 8	1.200	4.200	3.50	.450	1.267	.450	19.5
D 6	D 28	1.690	5.990	3.54	.650	1.794	.650	27.6
D 8	D 28	6.360	20.000	3.14	2.140	6.432	2.140	99.0
D 9	D 11	.000	20.800					
D 9	D 10	.000	11.000					
D 12	D 13	.000	14.000					
D 12	D 14	12.310	25.590	2.08				16.1
D 12	D 15	6.620	13.040	1.97				8.4
D 12	D 16	9.450	19.870	2.10				12.4
D 14	D 15	9.650	19.970	2.07				12.6
D 16	D 17	8.240	19.320	2.34				11.5
D 15	D 18	10.700	21.850	2.04				13.8
D 18	D 19	6.390	12.920	2.02				8.2
D 19	D 20	3.400	6.800	2.00				4.4
D 10	D 20	9.360	20.900	2.23				12.7
D 10	D 17	3.240	6.800	2.10				4.2
D 10	D 21	3.480	7.490	2.15				4.6
D 10	D 22	7.270	14.990	2.06				9.4
D 21	D 22	1.160	2.360	2.03				1.5
D 15	D 23	10.000	20.200	2.02				12.9
D 22	D 24	11.500	17.900	1.56				13.1
D 23	D 24	13.200	27.000	2.05				17.1
D 24	D 25	18.850	32.920	1.75				22.6
D 25	D 26	20.540	38.000	1.85				25.3
D 25	D 27	10.930	20.870	1.91				13.7
D 27	D 29	21.980	41.530	1.89				27.4
D 27	D 30	32.020	60.270	1.88				39.8
D 29	D 30	23.990	45.330	1.89				29.9
D 1	BUS 56	1.150	4.200	3.65	.400	1.237	1.237*	19.0
D 4	BUS 51	4.600	15.200	3.30	2.200	4.745	2.200	73.0
D 5	BUS 66	2.200	7.150	3.25	1.200	2.254	1.200	34.7
D 8	BUS 67	2.300	7.500	3.26	1.150	2.360	1.150	36.3
D 28	BUS 59	6.200	21.000	3.39	3.150	6.459	3.150	99.4
1	E 2	1.938	5.917	3.05	5.280	1.938	1.938*	29.8
1	E 5	5.403	22.304	4.13	4.920	6.133	4.920	94.4
2	E 3	4.699	19.797	4.21	4.380	5.384	4.380	82.8
2	E 4	5.811	17.632	3.03	3.740	5.796	3.740	89.2
2	E 5	5.695	17.388	3.05	3.400	5.694	3.400	87.6
3	E 4	6.701	17.103	2.55	3.460	6.277	3.460	96.6
4	E 5	1.335	4.211	3.15	1.280	1.352	1.280	20.8
6	E 11	9.498	19.890	2.09				12.4
6	E 12	12.291	25.581	2.08				16.1
6	E 13	6.615	13.027	1.97				8.4
7	E 8	.000	17.615					
7	E 9	.000	11.001					
9	E 10	3.181	8.450	2.66				46.5
9	E 14	12.711	27.038	2.13				16.8
10	E 11	8.205	19.207	2.34				11.4
12	E 13	22.092	19.988	.90				20.5
13	E 14	17.093	34.802	2.04				22.1
1	BUS 102	1.100	4.100	3.73	.520	1.193	.520	18.4

NO	NE	R	X	X/R	wC	wCcomp	wCset	Length
E 2	BUS 97	2.200	8.000	3.64	1.200	2.361	1.200	36.3
E 5	BUS 90	2.300	7.500	3.26	1.150	2.360	1.150	36.3

Appendix G

250 Bus Network

FDLF Based Results

Base Case A

G.1 Transmission Line Data
Transformer Data
Shunt Element Data

G.2 Bus Oriented Results

G.3 Line Flow Results

Sbase: 100.

Transmission Lines

NO	NE	R %	X %	X/R	wC*Sbase	Length
BUS 1	BUS 2	3.030	9.990	3.30	2.540	48.0
BUS 1	BUS 3	1.290	4.240	3.29	1.082	20.4
BUS 4	BUS 5	.176	.798	4.53	.210	3.2
BUS 3	BUS 5	2.410	10.800	4.48	2.840	43.7
BUS 5	BUS 6	1.190	5.400	4.54	1.426	21.7
BUS 6	BUS 7	.459	2.080	4.53	.550	8.4
BUS 8	BUS 9	.244	3.050	12.50	48.536	90.5
BUS 9	BUS 10	.258	3.220	12.48	51.278	95.6
BUS 4	BUS 11	2.090	6.880	3.29	1.748	33.1
BUS 5	BUS 11	2.030	6.820	3.36	1.738	32.4
BUS 11	BUS 12	.595	1.960	3.29	.502	9.4
BUS 2	BUS 12	1.870	6.160	3.29	1.572	29.6
BUS 3	BUS 12	4.840	16.000	3.31	4.060	76.8
BUS 7	BUS 12	.862	3.400	3.94	.874	14.7
BUS 11	BUS 13	2.225	7.310	3.29	1.876	35.2
BUS 12	BUS 14	2.150	7.070	3.29	1.816	34.0
BUS 13	BUS 15	7.440	24.440	3.28	6.268	117.8
BUS 14	BUS 15	5.950	19.500	3.28	5.020	94.1
BUS 12	BUS 16	2.120	8.340	3.93	2.140	36.2
BUS 15	BUS 17	1.320	4.370	3.31	1.363	21.0
BUS 16	BUS 17	4.540	18.010	3.97	4.660	77.9
BUS 17	BUS 18	1.230	5.050	4.11	1.298	21.4
BUS 18	BUS 19	1.190	4.930	4.14	1.142	20.8
BUS 19	BUS 20	2.520	11.700	4.64	2.980	46.5
BUS 15	BUS 19	1.200	3.940	3.28	1.010	19.0
BUS 20	BUS 21	1.830	8.490	4.64	2.160	33.8
BUS 21	BUS 22	2.090	9.700	4.64	2.460	38.6
BUS 22	BUS 23	3.420	15.900	4.65	4.040	63.2
BUS 23	BUS 24	1.350	4.920	3.64	1.450	22.3
BUS 23	BUS 25	1.560	8.000	5.13	1.967	30.3
BUS 25	BUS 27	3.180	16.300	5.13	4.009	61.7
BUS 27	BUS 28	1.913	8.550	4.47	2.160	34.7
BUS 28	BUS 29	2.370	9.430	3.98	2.380	40.7
BUS 8	BUS 30	.431	5.040	11.69	51.400	154.3
BUS 26	BUS 30	.799	8.600	10.76	90.800	274.2
BUS 17	BUS 31	4.740	15.630	3.30	3.990	75.2
BUS 29	BUS 31	1.080	3.310	3.06	.830	16.6
BUS 23	BUS 32	3.170	11.530	3.64	3.402	52.3
BUS 31	BUS 32	2.980	9.850	3.31	2.510	47.3
BUS 27	BUS 32	2.290	7.550	3.30	1.926	36.3
BUS 15	BUS 33	3.800	12.440	3.27	3.194	60.1
BUS 19	BUS 34	7.520	24.700	3.28	6.320	119.0
BUS 35	BUS 36	.224	1.020	4.55	.268	4.1
BUS 35	BUS 37	1.100	4.970	4.52	1.318	20.0
BUS 33	BUS 37	4.150	14.200	3.42	3.660	66.8
BUS 34	BUS 36	.871	2.680	3.08	.568	13.4
BUS 34	BUS 37	.256	.940	3.67	.276	4.2
BUS 37	BUS 39	3.210	10.600	3.30	2.700	50.9
BUS 37	BUS 40	5.930	16.800	2.83	4.200	88.7
BUS 30	BUS 38	.464	5.400	11.64	42.200	165.7
BUS 39	BUS 40	1.840	6.050	3.29	1.552	29.1

NO	NE	R %	X %	X/R	wC*Sbase	Length
BUS 40	BUS 41	1.450	4.780	3.30	1.222	23.0
BUS 40	BUS 42	5.550	18.300	3.30	4.660	88.0
BUS 41	BUS 42	4.100	13.500	3.29	3.440	65.0
BUS 43	BUS 44	6.080	24.540	4.04	6.068	105.1
BUS 34	BUS 43	4.130	16.810	4.07	4.226	71.7
BUS 44	BUS 45	2.240	9.010	4.02	2.240	38.7
BUS 45	BUS 46	4.000	13.560	3.39	3.320	64.1
BUS 46	BUS 47	3.800	12.700	3.34	3.160	60.6
BUS 46	BUS 48	6.010	18.900	3.14	4.720	93.5
BUS 47	BUS 49	1.910	6.250	3.27	1.604	30.2
BUS 42	BUS 49	7.150	32.300	4.52	8.600	130.3
BUS 42	BUS 49	7.150	32.300	4.52	8.600	130.3
BUS 45	BUS 49	6.840	18.600	2.72	4.440	100.8
BUS 48	BUS 49	1.790	5.050	2.82	1.258	26.7
BUS 49	BUS 50	2.670	7.520	2.82	1.874	39.8
BUS 49	BUS 51	4.860	13.700	2.82	3.420	72.5
BUS 51	BUS 52	2.030	5.880	2.90	1.396	30.6
BUS 52	BUS 53	4.050	16.350	4.04	4.060	70.0
BUS 53	BUS 54	2.630	12.200	4.64	2.100	48.5
BUS 49	BUS 54	7.300	28.900	3.96	7.380	125.1
BUS 49	BUS 54	8.690	29.100	3.35	7.300	138.6
BUS 54	BUS 55	1.690	7.070	4.18	2.020	29.7
BUS 54	BUS 56	.275	.955	3.47	.289	4.5
BUS 55	BUS 56	.488	1.510	3.09	.374	7.5
BUS 56	BUS 57	3.430	9.660	2.82	2.420	51.2
BUS 50	BUS 57	4.740	13.400	2.83	3.320	70.8
BUS 56	BUS 58	3.430	9.660	2.82	2.420	51.2
BUS 51	BUS 58	2.550	7.190	2.82	1.788	38.1
BUS 54	BUS 59	5.030	22.930	4.56	5.980	92.0
BUS 56	BUS 59	8.250	25.100	3.04	5.690	126.7
BUS 56	BUS 59	8.030	23.900	2.98	5.360	122.3
BUS 55	BUS 59	4.739	21.580	4.55	5.646	86.7
BUS 59	BUS 60	3.170	14.500	4.57	3.760	58.1
BUS 59	BUS 61	3.280	15.000	4.57	3.880	60.1
BUS 60	BUS 61	.264	1.350	5.11	.332	5.1
BUS 60	BUS 62	1.230	5.610	4.56	1.468	22.5
BUS 61	BUS 62	.824	3.760	4.56	.980	15.1
BUS 63	BUS 64	.172	2.000	11.63	21.600	61.4
BUS 38	BUS 65	.901	9.860	10.94	104.600	311.8
BUS 64	BUS 65	.269	3.020	11.23	38.000	94.3
BUS 49	BUS 66	1.800	9.190	5.11	2.480	34.8
BUS 49	BUS 66	1.800	9.190	5.11	2.480	34.8
BUS 62	BUS 66	4.820	21.800	4.52	5.980	87.9
BUS 62	BUS 67	2.580	11.700	4.53	3.100	47.1
BUS 66	BUS 67	2.240	10.150	4.53	2.682	40.9
BUS 65	BUS 68	.138	1.600	11.59	26.378	49.2
BUS 47	BUS 69	8.440	27.780	3.29	7.092	133.7
BUS 49	BUS 69	9.850	32.400	3.29	8.280	156.0
BUS 69	BUS 70	3.000	12.700	4.23	3.445	53.0
BUS 24	BUS 70	10.221	41.150	4.03	10.200	176.5
BUS 70	BUS 71	.882	3.550	4.02	.880	15.2
BUS 24	BUS 72	4.880	19.600	4.02	4.880	84.2

NO	NE	R %	X %	X/R	wC*Sbase	Length
BUS 71	BUS 72	4.460	18.000	4.04	4.444	77.1
BUS 71	BUS 73	.866	4.540	5.24	1.180	17.0
BUS 70	BUS 74	4.010	13.230	3.30	3.368	63.6
BUS 70	BUS 75	4.280	14.100	3.29	3.600	67.8
BUS 69	BUS 75	4.050	12.200	3.01	4.028	62.0
BUS 74	BUS 75	1.230	4.060	3.30	1.034	19.5
BUS 76	BUS 77	4.440	14.800	3.33	3.680	70.7
BUS 69	BUS 77	3.090	10.100	3.27	3.173	48.8
BUS 75	BUS 77	6.010	19.990	3.33	5.000	95.6
BUS 77	BUS 78	.376	1.240	3.30	.388	6.0
BUS 78	BUS 79	.546	2.440	4.47	.648	9.9
BUS 77	BUS 80	1.700	4.850	2.85	1.657	25.5
BUS 77	BUS 80	2.940	10.500	3.57	2.280	48.2
BUS 79	BUS 80	1.560	7.040	4.51	1.870	28.4
BUS 68	BUS 81	.175	2.020	11.54	33.373	62.2
BUS 77	BUS 82	2.980	8.530	2.86	2.910	44.7
BUS 82	BUS 83	1.120	3.665	3.27	1.151	17.7
BUS 83	BUS 84	5.180	13.200	2.55	2.600	74.6
BUS 83	BUS 85	4.300	14.800	3.44	3.480	69.4
BUS 84	BUS 85	2.510	6.410	2.55	1.234	36.2
BUS 85	BUS 86	3.500	12.300	3.51	2.760	57.0
BUS 86	BUS 87	2.828	20.740	7.33	35.892	201.5
BUS 85	BUS 88	2.000	10.200	5.10	2.760	38.7
BUS 85	BUS 89	2.390	17.300	7.24	30.120	169.1
BUS 88	BUS 89	1.390	7.120	5.12	1.934	27.0
BUS 89	BUS 90	5.180	18.800	3.63	5.280	85.5
BUS 89	BUS 90	2.380	9.970	4.19	2.720	41.8
BUS 90	BUS 91	2.540	8.360	3.29	2.140	40.2
BUS 89	BUS 92	.990	5.050	5.10	1.245	19.2
BUS 89	BUS 92	3.930	15.810	4.02	4.140	67.8
BUS 91	BUS 92	3.870	12.720	3.29	3.268	61.3
BUS 92	BUS 93	2.580	8.480	3.29	2.180	40.9
BUS 92	BUS 94	4.810	15.800	3.28	4.060	76.1
BUS 93	BUS 94	2.230	7.320	3.28	1.876	35.3
BUS 94	BUS 95	1.320	4.340	3.29	1.110	20.9
BUS 80	BUS 96	3.560	18.200	5.11	4.940	69.0
BUS 82	BUS 96	1.620	5.300	3.27	1.664	25.6
BUS 94	BUS 96	2.690	8.690	3.23	2.300	42.3
BUS 80	BUS 97	1.830	9.340	5.10	2.540	35.4
BUS 80	BUS 98	2.380	10.800	4.54	2.860	43.5
BUS 80	BUS 99	4.540	20.600	4.54	5.460	82.9
BUS 92	BUS 100	6.480	29.500	4.55	7.720	118.5
BUS 94	BUS 100	1.780	5.800	3.26	1.826	28.1
BUS 95	BUS 96	1.710	5.470	3.20	1.474	26.8
BUS 96	BUS 97	1.730	8.850	5.12	2.400	33.5
BUS 98	BUS 100	3.970	17.900	4.51	4.760	72.3
BUS 99	BUS 100	1.800	8.130	4.52	1.646	32.8
BUS 100	BUS 101	2.770	12.620	4.56	3.280	50.7
BUS 92	BUS 102	1.230	5.590	4.54	1.464	22.5
BUS 101	BUS 102	2.460	11.200	4.55	2.940	45.0
BUS 100	BUS 103	1.600	5.250	3.28	1.646	25.3
BUS 100	BUS 104	4.510	20.400	4.52	5.510	82.2

NO	NE	R %	X %	X/R	wC*Sbase	Length
BUS 103	BUS 104	4.660	15.840	3.40	4.070	74.8
BUS 103	BUS 105	5.350	16.250	3.04	4.080	82.1
BUS 100	BUS 106	6.050	22.900	3.79	6.200	101.6
BUS 104	BUS 105	.994	3.780	3.80	.986	16.7
BUS 105	BUS 106	1.400	5.470	3.91	1.434	23.9
BUS 105	BUS 107	5.300	18.300	3.45	4.720	85.6
BUS 105	BUS 108	2.610	7.030	2.69	1.844	38.3
BUS 106	BUS 107	5.300	18.300	3.45	4.720	85.6
BUS 108	BUS 109	1.050	2.880	2.74	.760	15.5
BUS 103	BUS 110	3.906	18.130	4.64	4.710	72.1
BUS 109	BUS 110	2.780	7.620	2.74	2.020	41.1
BUS 110	BUS 111	2.200	7.550	3.43	2.000	35.5
BUS 110	BUS 112	2.470	6.400	2.59	2.326	35.8
BUS 17	BUS 113	.913	3.010	3.30	.768	14.5
BUS 32	BUS 113	6.150	20.300	3.30	5.180	97.5
BUS 32	BUS 114	1.350	6.120	4.53	1.626	24.6
BUS 27	BUS 115	1.640	7.410	4.52	1.972	29.9
BUS 114	BUS 115	.230	1.040	4.52	.276	4.2
BUS 68	BUS 116	.034	.405	11.91	6.592	12.3
BUS 12	BUS 117	3.290	14.000	4.26	3.580	58.3
BUS 75	BUS 118	1.450	4.810	3.32	1.200	23.0
BUS 76	BUS 118	1.640	5.440	3.32	1.356	26.1
A 1	A 2	1.920	5.750	2.99	2.640	29.3
A 1	A 3	4.520	18.520	4.10	2.040	78.7
A 2	A 4	5.700	17.370	3.05	5.695	87.6
A 3	A 4	1.320	3.790	2.87	1.289	19.8
A 2	A 5	4.720	19.830	4.20	2.090	83.1
A 2	A 6	5.810	17.630	3.03	5.795	89.2
A 4	A 6	1.190	4.140	3.48	.450	19.3
A 5	A 7	4.600	13.800	3.00	4.568	70.3
A 6	A 7	2.670	8.200	3.07	2.676	41.2
A 6	A 8	1.200	4.200	3.50	.450	19.5
A 6	A 28	1.690	5.990	3.54	.650	27.6
A 8	A 28	6.360	20.000	3.14	2.140	99.0
A 9	A 11	.000	20.800			
A 9	A 10	.000	11.000			
A 12	A 13	.000	14.000			
A 12	A 14	12.310	25.590	2.08		16.1
A 12	A 15	6.620	13.040	1.97		8.4
A 12	A 16	9.450	19.870	2.10		12.4
A 14	A 15	9.650	19.970	2.07		12.6
A 16	A 17	8.240	19.320	2.34		11.5
A 15	A 18	10.700	21.850	2.04		13.8
A 18	A 19	6.390	12.920	2.02		8.2
A 19	A 20	3.400	6.800	2.00		4.4
A 10	A 20	9.360	20.900	2.23		12.7
A 10	A 17	3.240	6.800	2.10		4.2
A 10	A 21	3.480	7.490	2.15		4.6
A 10	A 22	7.270	14.990	2.06		9.4
A 21	A 22	1.160	2.360	2.03		1.5
A 15	A 23	10.000	20.200	2.02		12.9
A 22	A 24	11.500	17.900	1.56		13.1

NO	NE	R %	X %	X/R	wC*Sbase	Length
A 23	A 24	13.200	27.000	2.05		17.1
A 24	A 25	18.850	32.920	1.75		22.6
A 25	A 26	20.540	38.000	1.85		25.3
A 25	A 27	10.930	20.870	1.91		13.7
A 27	A 29	21.980	41.530	1.89		27.4
A 27	A 30	32.020	60.270	1.88		39.8
A 29	A 30	23.990	45.330	1.89		29.9
A 1	BUS 48	4.600	17.680	3.84	2.140	77.8
A 8	BUS 40	1.250	4.620	3.70	.480	20.8
A 2	BUS 45	2.600	8.100	3.12	2.620	40.3
A 28	BUS 42	2.110	6.850	3.25	1.890	33.2
A 5	BUS 44	1.900	5.600	2.95	2.600	28.8
B 1	B 2	1.920	5.750	2.99	2.640	29.3
B 1	B 3	4.520	18.520	4.10	2.040	78.7
B 2	B 4	5.700	17.370	3.05	5.695	87.6
B 3	B 4	1.320	3.790	2.87	1.289	19.8
B 2	B 5	4.720	19.830	4.20	2.090	83.1
B 2	B 6	5.810	17.630	3.03	5.795	89.2
B 4	B 6	1.190	4.140	3.48	.450	19.3
B 5	B 7	4.600	13.800	3.00	4.568	70.3
B 6	B 7	2.670	8.200	3.07	2.676	41.2
B 6	B 8	1.200	4.200	3.50	.450	19.5
B 6	B 28	1.690	5.990	3.54	.650	27.6
B 8	B 28	6.360	20.000	3.14	2.140	99.0
9	B 11	.000	20.800			
9	B 10	.000	11.000			
12	B 13	.000	14.000			
12	B 14	12.310	25.590	2.08		16.1
12	B 15	6.620	13.040	1.97		8.4
12	B 16	9.450	19.870	2.10		12.4
14	B 15	9.650	19.970	2.07		12.6
16	B 17	8.240	19.320	2.34		11.5
15	B 18	10.700	21.850	2.04		13.8
18	B 19	6.390	12.920	2.02		8.2
19	B 20	3.400	6.800	2.00		4.4
10	B 20	9.360	20.900	2.23		12.7
10	B 17	3.240	6.800	2.10		4.2
10	B 21	3.480	7.490	2.15		4.6
10	B 22	7.270	14.990	2.06		9.4
21	B 22	1.160	2.360	2.03		1.5
15	B 23	10.000	20.200	2.02		12.9
22	B 24	11.500	17.900	1.56		13.1
23	B 24	13.200	27.000	2.05		17.1
24	B 25	18.850	32.920	1.75		22.6
25	B 26	20.540	38.000	1.85		25.3
25	B 27	10.930	20.870	1.91		13.7
27	B 29	21.980	41.530	1.89		27.4
27	B 30	32.020	60.270	1.88		39.8
29	B 30	23.990	45.330	1.89		29.9
1	BUS 20	1.300	4.800	3.69	.520	21.6
4	BUS 21	2.500	8.200	3.28	2.571	39.6
8	BUS 22	2.300	7.900	3.43	2.410	37.1

NO	NE	R %	X %	X/R	wC*Sbase	Length
B 28	BUS 32	4.800	17.800	3.71	2.150	79.9
C 1	C 2	1.920	5.750	2.99	2.640	29.3
C 1	C 3	4.520	18.520	4.10	2.040	78.7
C 2	C 4	5.700	17.370	3.05	5.695	87.6
C 3	C 4	1.320	3.790	2.87	1.289	19.8
C 2	C 5	4.720	19.830	4.20	2.090	83.1
C 2	C 6	5.810	17.630	3.03	5.795	89.2
C 4	C 6	1.190	4.140	3.48	.450	19.3
C 5	C 7	4.600	13.800	3.00	4.568	70.3
C 6	C 7	2.670	8.200	3.07	2.676	41.2
C 6	C 8	1.200	4.200	3.50	.450	19.5
C 6	C 28	1.690	5.990	3.54	.650	27.6
C 8	C 28	6.360	20.000	3.14	2.140	99.0
C 9	C 11	.000	20.800			
C 9	C 10	.000	11.000			
C 12	C 13	.000	14.000			
C 12	C 14	12.310	25.590	2.08		16.1
C 12	C 15	6.620	13.040	1.97		8.4
C 12	C 16	9.450	19.870	2.10		12.4
C 14	C 15	9.650	19.970	2.07		12.6
C 16	C 17	8.240	19.320	2.34		11.5
C 15	C 18	10.700	21.850	2.04		13.8
C 18	C 19	6.390	12.920	2.02		8.2
C 19	C 20	3.400	6.800	2.00		4.4
C 10	C 20	9.360	20.900	2.23		12.7
C 10	C 17	3.240	6.800	2.10		4.2
C 10	C 21	3.480	7.490	2.15		4.6
C 10	C 22	7.270	14.990	2.06		9.4
C 21	C 22	1.160	2.360	2.03		1.5
C 15	C 23	10.000	20.200	2.02		12.9
C 22	C 24	11.500	17.900	1.56		13.1
C 23	C 24	13.200	27.000	2.05		17.1
C 24	C 25	18.850	32.920	1.75		22.6
C 25	C 26	20.540	38.000	1.85		25.3
C 25	C 27	10.930	20.870	1.91		13.7
C 27	C 29	21.980	41.530	1.89		27.4
C 27	C 30	32.020	60.270	1.88		39.8
C 29	C 30	23.990	45.330	1.89		29.9
C 28	BUS 82	1.250	4.580	3.66	.450	20.7
C 8	BUS 83	1.300	4.650	3.58	.520	21.3
C 5	BUS 85	1.500	4.820	3.21	.550	23.5
C 2	BUS 89	4.600	17.200	3.74	2.150	76.9
C 1	BUS 92	2.000	7.200	3.60	1.160	32.9
C 4	BUS 95	1.800	6.200	3.44	.950	29.1
C 1	D 2	1.920	5.750	2.99	2.640	29.3
C 1	D 3	4.520	18.520	4.10	2.040	78.7
C 2	D 4	5.700	17.370	3.05	5.695	87.6
C 3	D 4	1.320	3.790	2.87	1.289	19.8
C 2	D 5	4.720	19.830	4.20	2.090	83.1
C 2	D 6	5.810	17.630	3.03	5.795	89.2
C 4	D 6	1.190	4.140	3.48	.450	19.3
C 5	D 7	4.600	13.800	3.00	4.568	70.3

NO	NE	R %	X %	X/R	wC*Sbase	Length
D 6	D 7	2.670	8.200	3.07	2.676	41.2
D 6	D 8	1.200	4.200	3.50	.450	19.5
D 6	D 28	1.690	5.990	3.54	.650	27.6
D 8	D 28	6.360	20.000	3.14	2.140	99.0
D 9	D 11	.000	20.800			
D 9	D 10	.000	11.000			
D 12	D 13	.000	14.000			
D 12	D 14	12.310	25.590	2.08		16.1
D 12	D 15	6.620	13.040	1.97		8.4
D 12	D 16	9.450	19.870	2.10		12.4
D 14	D 15	9.650	19.970	2.07		12.6
D 16	D 17	8.240	19.320	2.34		11.5
D 15	D 18	10.700	21.850	2.04		13.8
D 18	D 19	6.390	12.920	2.02		8.2
D 19	D 20	3.400	6.800	2.00		4.4
D 10	D 20	9.360	20.900	2.23		12.7
D 10	D 17	3.240	6.800	2.10		4.2
D 10	D 21	3.480	7.490	2.15		4.6
D 10	D 22	7.270	14.990	2.06		9.4
D 21	D 22	1.160	2.360	2.03		1.5
D 15	D 23	10.000	20.200	2.02		12.9
D 22	D 24	11.500	17.900	1.56		13.1
D 23	D 24	13.200	27.000	2.05		17.1
D 24	D 25	18.850	32.920	1.75		22.6
D 25	D 26	20.540	38.000	1.85		25.3
D 25	D 27	10.930	20.870	1.91		13.7
D 27	D 29	21.980	41.530	1.89		27.4
D 27	D 30	32.020	60.270	1.88		39.8
D 29	D 30	23.990	45.330	1.89		29.9
D 1	BUS 56	1.150	4.200	3.65	1.237	19.0
D 4	BUS 51	4.600	15.200	3.30	2.200	73.0
D 5	BUS 66	2.200	7.150	3.25	1.200	34.7
D 8	BUS 67	2.300	7.500	3.26	1.150	36.3
D 28	BUS 59	6.200	21.000	3.39	3.150	99.4
E 1	E 2	1.938	5.917	3.05	1.938	29.8
E 1	E 5	5.403	22.304	4.13	4.920	94.4
E 2	E 3	4.699	19.797	4.21	4.380	82.8
E 2	E 4	5.811	17.632	3.03	3.740	89.2
E 2	E 5	5.695	17.388	3.05	3.400	87.6
E 3	E 4	6.701	17.103	2.55	3.460	96.6
E 4	E 5	1.335	4.211	3.15	1.280	20.8
E 6	E 11	9.498	19.890	2.09		12.4
E 6	E 12	12.291	25.581	2.08		16.1
E 6	E 13	6.615	13.027	1.97		8.4
E 7	E 8	.000	17.615			
E 7	E 9	.000	11.001			
E 9	E 10	3.181	8.450	2.66		46.5
E 9	E 14	12.711	27.038	2.13		16.8
E 10	E 11	8.205	19.207	2.34		11.4
E 12	E 13	22.092	19.988	.90		20.5
E 13	E 14	17.093	34.802	2.04		22.1
E 1	BUS 102	1.100	4.100	3.73	.520	18.4

NO	NE	R %	X %	X/R	wC*Sbase	Length
E 2	BUS 97	2.200	8.000	3.64	1.200	36.3
E 5	BUS 90	2.300	7.500	3.26	1.150	36.3

Transformers

NO	NE	R %	X %	Tap
BUS 8	BUS 5	.000	2.670	.985
BUS 26	BUS 25	.000	3.820	.960
BUS 30	BUS 17	.000	3.880	.960
BUS 38	BUS 37	.000	3.750	.935
BUS 63	BUS 59	.000	3.860	.960
BUS 64	BUS 61	.000	2.680	.985
BUS 65	BUS 66	.000	3.700	.935
BUS 68	BUS 69	.000	3.700	.935
BUS 81	BUS 80	.000	3.700	.935
A 6	A 9	.000	20.800	.978
A 6	A 10	.000	55.600	.969
A 4	A 12	.000	25.600	.932
A 28	A 27	.000	39.600	.968
B 6	B 9	.000	20.800	.978
B 6	B 10	.000	55.600	.969
B 4	B 12	.000	25.600	.932
B 28	B 27	.000	39.600	.968
C 6	C 9	.000	20.800	.978
C 6	C 10	.000	55.600	.969
C 4	C 12	.000	25.600	.932
C 28	C 27	.000	39.600	.968
D 6	D 9	.000	20.800	.978
D 6	D 10	.000	55.600	.969
D 4	D 12	.000	25.600	.932
D 28	D 27	.000	39.600	.968
E 4	E 7	.000	20.912	.978
E 4	E 9	.000	55.618	.969
E 5	E 6	.000	25.202	.932

Shunt Elements

NO	wC*Sbase
BUS 5	-40.000
BUS 17	.000
BUS 34	14.000
BUS 37	-25.000
BUS 44	10.000
BUS 45	10.000
BUS 46	10.000
BUS 48	15.000
BUS 74	12.000
BUS 79	20.000
BUS 82	20.000
BUS 83	10.000
BUS 105	20.000
BUS 107	6.000
BUS 110	6.000
A 10	19.011
A 24	4.000
B 10	19.011
B 24	4.000
C 10	19.011
C 24	4.000
D 10	19.011
D 24	4.000
E 9	19.000

```
    Time for input:  3.28
    Time for compact:   .25
    Time for factorization:   .30
No. of iterations:  9.5
Maximum mismatch (in pu):  8.7E-04 5.6E-04
    Time for solution:   .26
Execution time:  4.08

S base : 100.
```

Bus	Vsp	Voltage		Generation		QGmin	QGmax	Load	
BUS 69		1.035	30.00	194.15	-35.71				
BUS 1	.960	.960	18.35	.00	12.92	-5.00	35.00	51.00	27.00
BUS 4	.998	.998	23.89	50.00	-12.39	-300.00	300.00	30.00	12.00
BUS 6	.990	.990	20.78	.00	31.66	-13.00	50.00	52.00	22.00
BUS 8	1.015	1.015	29.58	40.00	144.85	-300.00	300.00	.00	10.00
BUS 10	1.055	1.055	44.49	450.00	34.26	-147.00	200.00	.00	.00
BUS 12	.990	.990	20.04	85.00	112.26	-35.00	120.00	47.00	20.00
BUS 15	.970	.970	18.83	.00	-5.46	-10.00	50.00	90.00	40.00
BUS 18	.973	.973	19.17	.00	8.47	-16.00	50.00	60.00	34.00
BUS 19	.960	.972+	18.50	.00	-8.00	-8.00	24.00	45.00	25.00
BUS 24	.992	.992	29.72	49.00	-10.32	-300.00	300.00	.00	.00
BUS 25	1.050	1.050	35.78	220.00	70.80	-47.00	140.00	.00	.00
BUS 26	1.015	1.015	37.51	314.00	10.30	-1000.00	1000.00	.00	.00
BUS 27	.968	.968	25.08	45.00	-9.99	-300.00	300.00	20.00	13.00
BUS 31	.967	.967	21.00	7.00	40.49	-300.00	300.00	43.00	27.00
BUS 32	.963	.964+	22.71	.00	-14.00	-14.00	42.00	59.00	23.00
BUS 34	.984	.987+	17.67	.00	-8.00	-8.00	24.00	59.00	26.00
BUS 36	.980	.980	17.28	.00	.68	-8.00	24.00	31.00	17.00
BUS 40	.970	.970	14.20	-46.00	-35.26	-300.00	300.00	20.00	23.00
BUS 42	.985	.985	14.46	-59.00	26.92	-300.00	300.00	37.00	23.00
BUS 46	1.080	1.080	22.57	89.00	91.58	-100.00	100.00	28.00	10.00
BUS 49	1.025	1.025	24.69	204.00	.93	-85.00	210.00	87.00	30.00
BUS 54	.970	.970	21.80	48.00	-20.07	-300.00	300.00	113.00	52.00
BUS 55	.970	.970	21.58	.00	2.84	-8.00	23.00	63.00	22.00
BUS 56	.970	.974+	21.90	.00	-7.78	-8.00	15.00	84.00	38.00
BUS 59	.985	.985	23.94	155.00	42.50	-60.00	180.00	277.00	113.00
BUS 61	.995	.995	27.39	160.00	-13.97	-100.00	300.00	.00	.00
BUS 62	.998	.998	26.36	.00	20.70	-20.00	30.00	77.00	24.00
BUS 65	1.005	1.005	30.51	391.00	101.78	-67.00	200.00	.00	.00
BUS 66	1.050	1.050	29.67	392.00	38.59	-67.00	200.00	39.00	18.00
BUS 70	.984	.984+	27.07	.00	-10.00	-10.00	32.00	66.00	20.00
BUS 72	.980	.980	31.72	43.00	-23.87	-100.00	100.00	.00	.00
BUS 73	.991	.991	29.44	37.00	1.10	-100.00	100.00	.00	.00
BUS 74	.975	.975	24.30	.00	27.60	-6.00	39.00	68.00	27.00
BUS 76	.970	.970	24.48	.00	41.53	-8.00	80.00	68.00	37.00
BUS 77	1.006	1.006+	30.74	.00	-20.00	-20.00	70.00	61.00	20.00
BUS 80	1.040	1.040	33.71	477.00	175.03	-165.00	280.00	130.00	56.00
BUS 85	1.020	1.020	36.82	.00	3.02	-8.00	23.00	24.00	15.00
BUS 87	1.015	1.015	36.06	4.00	-22.23	-100.00	1000.00	.00	.00
BUS 89	1.055	1.055	43.79	607.00	114.16	-210.00	300.00	.00	.00
BUS 90	.985	.985	37.41	-85.00	-13.91	-300.00	300.00	78.00	52.00
BUS 91	.985	.985	39.50	20.00	-44.66	-100.00	100.00	.00	.00
BUS 92	1.030	1.033+	40.19	.00	-3.00	-3.00	20.00	65.00	20.00
BUS 99	1.015	1.015	38.16	35.00	-24.64	-100.00	100.00	.00	.00
BUS 100	1.017	1.017	38.17	252.00	57.47	-50.00	155.00	37.00	18.00

BUS 103	1.000	1.000	36.64	40.00	31.40	-15.00	50.00	23.00	16.00
BUS 104	.971	.971	34.42	.00	6.57	-8.00	53.00	38.00	25.00
BUS 107	.980	.980	34.37	45.00	17.02	-200.00	200.00	28.00	12.00
BUS 111	.980	.980	36.99	36.00	4.66	-100.00	1000.00	.00	.00
BUS 112	.975	.975	36.59	55.00	11.36	-100.00	1000.00	25.00	13.00
BUS 116	1.005	1.005	29.51	-184.00	104.56	-1000.00	1000.00	.00	.00
A 1	1.050	1.050	21.39	100.00	4.11	-100.00	100.00	.00	.00
A 2	1.045	1.045	19.11	80.00	77.66	-20.00	80.00	21.70	12.70
A 5	1.010	1.010	15.73	50.00	32.51	-15.00	62.45	94.20	39.00
A 8	1.000	.998-	14.43	20.00	85.00	-15.00	85.00	30.00	30.00
A 11	1.050	1.050	16.09	20.00	8.48	-10.00	45.83	.00	.00
A 13	1.050	1.050	14.42	20.00	4.71	-15.00	56.57	.00	.00
B 1	1.050	1.050	20.17	100.00	69.35	-100.00	100.00	.00	.00
B 2	1.045	1.045	19.55	80.00	42.28	-20.00	60.00	21.70	12.70
B 5	1.010	1.010	15.74	50.00	36.83	-15.00	62.45	94.20	39.00
B 8	1.010	1.010	18.21	20.00	63.10	-15.00	75.00	30.00	30.00
B 11	1.050	1.050	18.76	20.00	7.06	-10.00	45.83	.00	.00
B 13	1.050	1.050	16.73	20.00	4.20	-15.00	56.57	.00	.00
C 1	1.050	1.050	40.85	100.00	24.36	-100.00	100.00	.00	.00
C 2	1.045	1.045	39.83	80.00	37.72	-20.00	60.00	21.70	12.70
C 5	1.010	1.010	36.22	50.00	14.98	-15.00	62.45	94.20	39.00
C 8	1.010	1.010	34.34	20.00	43.10	-15.00	75.00	30.00	30.00
C 11	1.050	1.050	35.82	20.00	6.78	-10.00	45.83	.00	.00
C 13	1.050	1.050	34.12	20.00	3.82	-15.00	56.57	.00	.00
D 1	1.025	1.021-	24.26	100.00	100.00	-100.00	100.00	.00	.00
D 2	1.020	1.020	25.33	80.00	9.60	-20.00	60.00	21.70	12.70
D 5	1.010	1.010	26.69	50.00	-1.21	-15.00	62.45	94.20	39.00
D 8	1.010	1.010	24.26	20.00	46.69	-15.00	75.00	30.00	30.00
D 11	1.050	1.050	24.43	20.00	8.35	-10.00	45.83	.00	.00
D 13	1.050	1.050	22.15	20.00	7.02	-15.00	56.57	.00	.00
E 1	1.060	1.060	40.06	250.00	83.59	-40.00	90.00	20.00	12.00
E 2	1.045	1.028-	35.75	40.00	50.00	-40.00	50.00	21.70	12.70
E 3	.970	.970	28.74	.00	31.82	.00	70.00	94.20	39.00
E 6	1.040	1.040	28.22	.00	15.95	-6.00	34.00	11.20	7.50
E 8	1.050	1.050	28.97	.00	15.83	-6.00	34.00	.00	.00

Bus	Voltage		Load	
BUS 2	.973	19.00	20.00	9.00
BUS 3	.967	19.32	50.00	20.00
BUS 5	1.001	24.13	40.00	18.00
BUS 7	.987	20.14	51.00	14.00
BUS 9	1.034	36.94	.00	.00
BUS 11	.985	20.78	70.00	23.00
BUS 13	.968	19.31	34.00	16.00
BUS 14	.981	19.31	14.00	5.00
BUS 16	.984	19.70	25.00	10.00
BUS 17	.995	21.45	11.00	3.00
BUS 20	1.017	19.09	18.00	7.00
BUS 21	1.002	18.18	44.00	15.00
BUS 22	.995	19.49	45.00	13.00
BUS 23	.991	28.11	62.00	28.00
BUS 28	.960	22.79	17.00	7.00
BUS 29	.960	21.17	24.00	14.00
BUS 30	.985	26.45	.00	.00
BUS 33	.972	17.67	23.00	9.00
BUS 35	.980	17.29	33.00	19.00
BUS 37	.993	18.17	.00	.00
BUS 38	.964	23.09	.00	.00
BUS 39	.971	15.10	27.00	11.00
BUS 41	.967	13.53	37.00	10.00
BUS 43	.991	16.18	18.00	7.00
BUS 44	1.013	16.51	16.00	8.00
BUS 45	1.022	18.76	83.00	45.00
BUS 47	1.026	23.64	64.00	30.00
BUS 48	1.039	23.26	20.00	11.00
BUS 50	1.007	23.34	17.00	4.00
BUS 51	.986	22.12	17.00	8.00
BUS 52	.975	21.32	18.00	5.00
BUS 53	.962	20.69	23.00	11.00
BUS 57	.985	22.12	12.00	3.00
BUS 58	.979	21.74	12.00	3.00
BUS 60	.989	26.56	78.00	43.00
BUS 63	.970	26.57	.00	.00
BUS 64	.984	27.92	.00	.00
BUS 67	1.016	26.07	28.00	7.00
BUS 68	1.001	29.96	.00	.00
BUS 71	.987	28.46	.00	.00
BUS 75	.975	25.22	80.00	25.00
BUS 78	1.004	30.52	71.00	26.00
BUS 79	1.009	30.99	39.00	32.00
BUS 81	.993	31.41	.00	.00
BUS 82	1.003	33.22	54.00	27.00
BUS 83	1.008	34.10	20.00	10.00
BUS 84	1.012	35.72	11.00	7.00
BUS 86	1.022	35.55	21.00	10.00
BUS 88	1.026	40.00	48.00	25.00
BUS 93	1.015	38.06	12.00	7.00
BUS 94	1.008	36.61	30.00	16.00
BUS 95	1.000	35.34	42.00	31.00
BUS 96	1.006	34.32	38.00	15.00
BUS 97	1.021	34.43	15.00	9.00
BUS 98	.990	33.31	64.00	48.00
BUS 101	1.020	38.29	22.00	15.00

BUS 102	1.042	39.56	25.00	3.00
BUS 105	.965	33.95	31.00	34.00
BUS 106	.957	33.39	69.00	36.00
BUS 108	.957	33.64	2.00	1.00
BUS 109	.954	33.54	48.00	10.00
BUS 110	.968	35.42	39.00	25.10
BUS 113	.993	21.47	6.00	-6.40
BUS 114	.957	22.64	20.00	3.00
BUS 115	.957	22.76	35.00	10.00
BUS 117	.974	18.49	20.00	8.00
BUS 118	.966	24.42	33.00	15.00
A 3	1.016	17.07	2.40	1.20
A 4	1.008	16.22	7.60	1.60
A 6	1.003	15.21	.00	.00
A 7	.998	14.81	22.80	10.90
A 9	1.034	13.90	.00	.00
A 10	1.031	12.02	5.80	2.00
A 12	1.044	12.95	11.20	7.50
A 14	1.029	12.02	6.20	1.60
A 15	1.025	11.88	8.20	2.50
A 16	1.032	12.30	3.50	1.80
A 17	1.026	11.92	9.00	5.80
A 18	1.015	11.22	3.20	.90
A 19	1.012	11.02	9.50	3.40
A 20	1.016	11.21	2.20	.70
A 21	1.020	11.56	17.50	11.20
A 22	1.021	11.57	.00	.00
A 23	1.017	11.39	3.20	1.60
A 24	1.013	11.10	8.70	6.70
A 25	1.021	11.19	.00	.00
A 26	1.005	10.71	3.50	2.30
A 27	1.035	11.52	.00	.00
A 28	.992	14.59	.00	.00
A 29	1.022	10.92	2.40	.90
A 30	1.017	10.65	7.40	2.70
B 3	1.017	18.39	2.40	1.20
B 4	1.010	18.10	7.60	1.60
B 6	1.008	17.94	.00	.00
B 7	1.001	16.52	22.80	10.90
B 9	1.037	16.57	.00	.00
B 10	1.034	14.67	5.80	2.00
B 12	1.045	15.27	11.20	7.50
B 14	1.030	14.40	6.20	1.60
B 15	1.027	14.31	8.20	2.50
B 16	1.033	14.76	3.50	1.80
B 17	1.029	14.52	9.00	5.80
B 18	1.017	13.73	3.20	.90
B 19	1.015	13.57	9.50	3.40
B 20	1.019	13.79	2.20	.70
B 21	1.023	14.23	17.50	11.20
B 22	1.024	14.25	.00	.00
B 23	1.019	13.99	3.20	1.60
24	1.017	13.91	8.70	6.70
25	1.026	14.49	.00	.00
26	1.010	14.02	3.50	2.30
27	1.040	15.11	.00	.00
28	.995	18.62	.00	.00
29	1.028	14.52	2.40	.90
30	1.023	14.25	7.40	2.70
3	1.016	36.68	2.40	1.20

C 4	1.008	35.87	7.60	1.60
C 6	1.009	34.98	.00	.00
C 7	1.001	34.85	22.80	10.90
C 9	1.037	33.63	.00	.00
C 10	1.035	31.74	5.80	2.00
C 12	1.045	32.66	11.20	7.50
C 14	1.030	31.73	6.20	1.60
C 15	1.027	31.58	8.20	2.50
C 16	1.034	32.01	3.50	1.80
C 17	1.030	31.64	9.00	5.80
C 18	1.018	30.93	3.20	.90
C 19	1.015	30.74	9.50	3.40
C 20	1.019	30.93	2.20	.70
C 21	1.024	31.27	17.50	11.20
C 22	1.025	31.27	.00	.00
C 23	1.020	31.07	3.20	1.60
C 24	1.018	30.75	8.70	6.70
C 25	1.028	30.68	.00	.00
C 26	1.013	30.21	3.50	2.30
C 27	1.043	30.91	.00	.00
C 28	1.003	33.87	.00	.00
C 29	1.031	30.32	2.40	.90
C 30	1.026	30.06	7.40	2.70
D 3	1.004	23.48	2.40	1.20
D 4	1.000	23.39	7.60	1.60
D 6	1.003	23.75	.00	.00
D 7	.998	24.25	22.80	10.90
D 9	1.034	22.23	.00	.00
D 10	1.032	20.25	5.80	2.00
D 12	1.041	20.68	11.20	7.50
D 14	1.026	19.83	6.20	1.60
D 15	1.023	19.74	8.20	2.50
D 16	1.030	20.24	3.50	1.80
D 17	1.026	20.08	9.00	5.80
D 18	1.014	19.20	3.20	.90
D 19	1.012	19.08	9.50	3.40
D 20	1.016	19.32	2.20	.70
D 21	1.020	19.78	17.50	11.20
D 22	1.021	19.80	.00	.00
D 23	1.016	19.41	3.20	1.60
D 24	1.014	19.34	8.70	6.70
D 25	1.025	19.71	.00	.00
D 26	1.009	19.23	3.50	2.30
D 27	1.040	20.21	.00	.00
D 28	.997	23.56	.00	.00
D 29	1.028	19.61	2.40	.90
D 30	1.022	19.34	7.40	2.70
E 4	.982	32.13	47.80	20.00
E 5	.990	34.22	7.60	1.60
E 7	1.023	28.97	.00	.00
E 9	1.018	27.34	29.50	16.60
E 10	1.014	27.19	9.00	5.80
E 11	1.023	27.57	3.50	1.80
E 12	1.024	27.30	6.10	1.60
E 13	1.019	27.22	13.50	5.80
E 14	1.000	26.21	14.90	5.00

Power Generated:	5620.15	1978.44
Power Demanded:	5468.80	2575.10
System Losses:	151.35	-596.66

BUS 99	BUS 47	40.38	-10.29
BUS 99	BUS 49	28.02	-6.99
BUS 69	BUS 70	48.30	28.08
BUS 69	BUS 75	76.19	25.41
BUS 69	BUS 77	-3.87	29.18
BUS 69	BUS 68	2.18	-100.45
Total:		194.15	-35.71
BUS 1	BUS 2	-13.14	-6.80
BUS 1	BUS 3	-37.86	-4.18
Total:		-51.00	-14.08
BUS 4	BUS 5	-56.87	-21.58
BUS 4	BUS 11	76.87	-2.82
Total:		20.00	-24.39
BUS 6	BUS 5	-105.82	5.04
BUS 6	BUS 7	53.82	3.82
Total:		52.00	8.86
BUS 8	BUS 9	-440.82	-23.83
BUS 8	BUS 30	113.20	25.84
BUS 8	BUS 6	367.42	132.26
Total:		40.00	134.85
BUS 10	BUS 8	450.00	34.28
Total:		450.00	34.28
BUS 12	BUS 11	-51.48	42.61
BUS 12	BUS 2	33.48	16.17
BUS 12	BUS 3	10.88	8.10
BUS 12	BUS 7	-2.47	8.84
BUS 12	BUS 14	18.38	6.26
BUS 12	BUS 16	6.09	4.28
BUS 12	BUS 117	20.15	6.20
Total:		36.00	82.26
BUS 15	BUS 13	-2.67	-1.31
BUS 15	BUS 14	-5.26	-8.44
BUS 15	BUS 17	-106.88	-21.10
BUS 15	BUS 18	11.17	-8.86
BUS 15	BUS 33	13.74	-7.06
Total:		-90.00	-46.46
BUS 18	BUS 17	-51.42	-21.26
BUS 18	BUS 19	21.42	-4.26
Total:		-30.00	-26.53
BUS 19	BUS 16	-21.36	3.41
BUS 19	BUS 20	-16.02	-36.26
BUS 19	BUS 18	-11.16	8.70
BUS 19	BUS 34	3.52	-8.86
Total:		-45.00	-33.00
BUS 24	BUS 23	52.83	-12.36
BUS 24	BUS 70	10.84	-5.81
BUS 24	BUS 72	-14.76	7.85
Total:		48.00	-10.32
BUS 25	BUS 23	183.97	52.18
BUS 25	BUS 27	123.84	37.35
BUS 25	BUS 26	-87.81	-18.72
Total:		220.00	70.80
BUS 29	BUS 30	226.48	-11.20
BUS 29	BUS 25	87.51	21.50
Total:		314.00	10.30
BUS 27	BUS 25	-118.68	-18.67
BUS 27	BUS 26	43.46	-.88
BUS 27	BUS 32	48.62	-8.63
BUS 27	BUS 115	51.91	3.29
Total:		25.00	-22.89
BUS 31	BUS 17	-9.26	-18.25
BUS 31	BUS 29	-1.85	18.81
BUS 31	BUS 32	-24.90	10.22
Total:		-36.00	13.48
BUS 32	BUS 33	-77.41	.43
BUS 32	BUS 31	25.14	-11.77
BUS 32	BUS 27	-48.02	8.98
BUS 32	BUS 113	5.61	-17.83
BUS 32	BUS 114	3.55	6.36
BUS 32	B 26	31.90	-25.18

	Total:	-89.00	-37.00
BUS 34	BUS 19	-3.47	3.95
BUS 34	BUS 28	30.07	16.43
BUS 34	BUS 37	-89.40	-33.18
BUS 34	BUS 43	13.80	-7.58
BUS 34	BUS 34	.00	-13.84
	Total:	-59.00	-34.00
BUS 36	BUS 35	-1.02	.34
BUS 36	BUS 34	-29.87	-16.86
	Total:	-31.00	-16.52
BUS 40	BUS 37	-36.02	-.06
BUS 40	BUS 38	-22.75	4.88
BUS 40	BUS 41	22.84	-1.07
BUS 40	BUS 42	-4.40	-5.80
BUS 40	A 6	-22.77	-83.18
	Total:	-58.00	-58.25
BUS 42	BUS 40	4.43	4.47
BUS 42	BUS 41	14.28	7.31
BUS 42	BUS 46	-54.44	.86
BUS 42	BUS 42	-54.44	.86
BUS 42	A 28	-5.83	-9.16
	Total:	-99.00	3.82
BUS 48	BUS 46	82.86	27.81
BUS 48	BUS 47	-2.17	46.11
BUS 48	BUS 48	.28	20.82
BUS 48	BUS 45	.00	-11.88
	Total:	81.00	81.86
BUS 46	BUS 47	27.88	-10.31
BUS 46	BUS 42	56.84	.81
BUS 49	BUS 42	56.84	.81
BUS 48	BUS 46	82.81	-17.06
BUS 48	BUS 48	37.83	-41.88
BUS 49	BUS 50	38.88	11.03
BUS 48	BUS 51	36.90	14.85
BUS 49	BUS 54	21.05	10.75
BUS 48	BUS 54	21.25	8.83
BUS 48	BUS 88	-102.28	-4.74
BUS 48	BUS 88	-102.28	-4.74
BUS 49	BUS 88	-28.23	2.47
	Total:	117.00	-28.08
BUS 54	BUS 53	15.41	1.84
BUS 54	BUS 48	-20.89	-18.28
BUS 54	BUS 48	-20.73	-15.14
BUS 54	BUS 55	4.77	-2.06
BUS 54	BUS 58	-27.71	-34.84
BUS 54	BUS 58	-15.13	-5.33
	Total:	-84.88	-71.85
BUS 56	BUS 54	-4.77	.20
BUS 56	BUS 58	-38.50	-14.38
BUS 56	BUS 59	-15.73	-4.81
	Total:	-83.00	-19.00
BUS 56	BUS 54	27.77	34.87
BUS 56	BUS 56	39.88	14.31
BUS 56	BUS 57	-8.92	-8.84
BUS 56	BUS 58	1.10	-5.83
BUS 56	BUS 58	-13.48	-2.22
BUS 56	BUS 58	-14.10	-1.95
BUS 56	D 1	-117.88	-75.28
	Total:	-84.00	-48.00
BUS 58	BUS 54	15.28	.28
BUS 58	BUS 56	13.81	-2.78
BUS 58	BUS 58	14.27	-2.58
BUS 58	BUS 58	15.81	.33
BUS 59	BUS 90	-29.58	2.58
BUS 58	BUS 81	-38.87	1.18
BUS 58	D 25	1.32	-7.81
BUS 58	BUS 82	-118.03	-81.81
	Total:	-122.00	-70.50
BUS 61	BUS 59	38.18	-2.87
BUS 61	BUS 80	110.83	22.82
BUS 61	BUS 62	44.08	-17.85
BUS 61	BUS 84	-34.18	-15.17
	Total:	180.00	-13.87
BUS 82	BUS 80	-2.87	18.70
BUS 82	BUS 81	-43.88	17.53
BUS 82	BUS 88	-31.31	-18.08
BUS 82	BUS 87	.77	-17.47
	Total:	-77.00	-3.30
BUS 85	BUS 35	130.43	-14.84
BUS 85	BUS 84	183.24	38.04
BUS 85	BUS 88	82.31	4.81

BUS 85	BUS 88	45.02	72.57
Total:		381.00	101.78
BUS 86	BUS 49	104.08	11.23
BUS 86	BUS 48	104.08	11.23
BUS 86	BUS 82	31.81	16.50
BUS 86	BUS 87	70.58	19.89
BUS 86	D 5	87.41	33.18
BUS 86	BUS 45	-46.02	-70.23
Total:		353.00	20.59
BUS 70	BUS 69	-47.38	-28.70
BUS 70	BUS 24	-10.72	-3.88
BUS 70	BUS 71	-84.18	8.84
BUS 70	BUS 74	34.23	-4.21
BUS 70	BUS 75	22.03	-1.78
Total:		-88.00	-30.00
BUS 72	JS 24	14.82	-11.75
BUP 72	BUS 71	28.08	-12.11
Total:		43.00	-23.87
BUS 73	BUS 71	37.00	1.10
Total:		37.00	1.10
BUS 74	BUS 70	-33.74	2.88
BUS 74	BUS 75	-34.28	8.41
BUS 74	BUS 74	.00	-11.41
Total:		-88.00	.80
BUS 76	BUS 77	-71.38	-.08
BUS 76	BUS 118	3.35	4.89
Total:		-88.00	4.83
BUS 77	BUS 76	73.78	4.48
BUS 77	BUS 88	4.14	-31.87
BUS 77	BUS 75	48.24	.74
BUS 77	BUS 78	33.80	10.80
BUS 77	BUS 80	-120.80	-25.88
BUS 77	BUS 80	-88.87	-16.82
BUS 77	BUS 82	-44.37	16.38
Total:		-81.00	-40.00
BUS 80	BUS 77	123.15	31.82
BUS 80	BUS 77	86.88	17.73
BUS 80	BUS 78	77.32	25.06
BUS 80	BUS 88	-2.16	17.22
BUS 80	BUS 87	-8.73	21.47
BUS 80	BUS 88	16.41	42.81
BUS 80	BUS 85	-34.84	16.81
BUS 80	BUS 81	120.03	-88.88
Total:		347.00	118.03
BUS 88	BUS 83	32.87	-2.11
BUS 85	BUS 84	31.33	.61
BUS 85	BUS 88	17.12	-7.41
BUS 85	BUS 88	-55.85	8.45
BUS 85	BUS 88	-78.25	-21.17
BUS 85	C 8	28.48	12.78
Total:		-24.00	-11.85
BUS 87	BUS 88	4.00	-22.23
Total:		4.00	-22.23
BUS 88	BUS 85	77.81	-1.84
BUS 88	BUS 88	105.83	28.22
BUS 88	BUS 80	88.02	21.02
BUS 88	BUS 80	127.78	48.82
BUS 88	BUS 82	140.20	23.08
BUS 88	BUS 82	44.81	2.87
BUS 88	C 2	43.18	-8.08
Total:		807.00	114.18
BUS 80	BUS 88	-88.80	-17.74
BUS 80	BUS 88	-123.73	-34.48
BUS 80	BUS 81	-38.88	11.48
BUS 80	E 8	84.88	-28.13
Total:		-183.00	-88.81
BUS 81	BUS 80	38.88	-12.11
BUS 81	BUS 82	-18.88	-32.88
Total:		20.00	-44.88
BUS 82	BUS 88	-138.40	-18.24
BUS 82	BUS 88	-43.88	-4.82
BUS 82	BUS 81	18.81	30.88
BUS 82	BUS 83	48.11	8.88
BUS 82	BUS 84	42.84	2.47
BUS 82	BUS 100	13.17	-1.38
BUS 82	BUS 102	18.43	-21.88

BUS 92	C 1	-22.47	-10.26
	Total:	-88.00	-23.00
BUS 88	BUS 80	38.96	-21.44
BUS 96	BUS 100	-.58	-3.20
	Total:	38.00	-24.94
BUS 100	BUS 92	-13.08	-8.26
BUS 100	BUS 94	48.75	1.27
BUS 100	BUS 96	48.02	3.81
BUS 100	BUS 98	.68	1.51
BUS 100	BUS 101	-2.22	-4.01
BUS 100	BUS 103	68.84	18.51
BUS 100	BUS 104	35.17	13.34
BUS 100	BUS 108	40.03	14.20
	Total:	216.00	38.47
BUS 103	BUS 100	-68.10	-18.42
BUS 103	BUS 104	28.88	8.82
BUS 103	BUS 108	31.72	9.68
BUS 103	BUS 110	14.80	12.32
	Total:	17.00	18.40
BUS 104	BUS 100	-34.52	-18.83
BUS 104	BUS 103	-26.48	-11.46
BUS 104	BUS 108	23.01	8.86
	Total:	-38.00	-18.43
BUS 107	BUS 108	8.63	4.12
BUS 107	BUS 108	11.37	8.88
BUS 107	BUS 107	.00	-8.78
	Total:	17.00	8.02
BUS 111	BUS 110	38.00	4.88
	Total:	38.00	4.88
BUS 112	BUS 110	30.00	-1.84
	Total:	30.00	-1.84
BUS 118	BUS 88	-184.00	104.88
	Total:	-184.00	104.88
A 1	A 2	71.48	-14.58
A 1	A 3	48.78	8.82
A 1	BUS 46	-17.22	10.15
	Total:	100.00	4.11
A 2	A 1	-70.54	14.63
A 2	A 4	34.43	8.86
A 2	A 6	34.06	10.12
A 2	A 8	44.31	8.86
A 2	BUS 48	18.08	23.11
	Total:	58.30	54.98
A 5	A 2	-33.50	-8.86
A 5	A 7	13.32	2.28
A 5	BUS 44	-24.03	1.21
	Total:	-44.20	-5.48
A 8	A 9	-32.82	-1.51
A 8	A 28	-.38	2.15
A 8	BUS 40	23.22	84.36
	Total:	-10.00	85.00
A 11	A 9	20.00	8.48
	Total:	20.00	8.48
A 13	A 12	20.00	4.71
	Total:	20.00	4.71
B 1	B 2	21.82	.80
B 1	B 3	21.33	12.80
B 1	BUS 20	57.28	88.28
	Total:	100.00	89.38
B 2	B 1	-21.43	-3.26
B 2	B 4	20.18	17.46
B 2	B 5	37.88	8.47
B 2	B 8	31.72	11.88
	Total:	68.30	28.58

B 6	B 2	-37.19	-8.87
B 6	B 7	-7.01	8.70
	Total:	-44.20	-2.17
B 8	B 8	11.88	1.37
B 8	B 28	-1.88	8.84
B 8	BUS 22	-20.78	24.78
	Total:	-10.00	33.10
B 11	B 9	20.00	7.08
	Total:	20.00	7.08
B 12	B 12	20.00	4.20
	Total:	20.00	4.20
C 1	C 2	33.14	-3.08
C 1	C 3	44.23	8.78
C 1	BUS 92	22.63	19.87
	Total:	100.00	24.38
C 2	C 1	-32.88	.77
C 2	C 4	44.88	8.88
C 2	C 8	36.18	9.78
C 2	C 5	52.64	3.18
C 2	BUS 88	-42.42	8.82
	Total:	88.30	25.02
C 5	C 2	-36.88	-8.37
C 5	C 7	17.71	-1.74
C 5	BUS 88	-28.37	-12.91
	Total:	-44.20	-24.02
C 8	C 8	-24.44	10.21
C 8	C 28	4.78	.88
C 8	BUS 83	9.88	2.00
	Total:	-10.00	13.10
C 11	C 9	20.00	8.78
	Total:	20.00	8.78
C 13	C 12	20.00	3.82
	Total:	20.00	3.82
D 1	D 2	-28.88	10.87
D 1	D 3	8.32	8.38
D 1	BUS 88	120.38	82.84
	Total:	100.00	100.00
D 2	D 1	28.87	-13.18
D 2	D 4	21.82	2.14
D 2	D 8	-10.48	8.70
D 2	D 5	17.40	1.21
	Total:	88.30	-3.10
D 5	D 2	10.88	-8.83
D 5	D 7	30.80	-2.82
D 5	BUS 88	-85.88	-28.78
	Total:	-44.20	-40.21
D 8	D 8	24.30	8.38
D 8	D 28	7.48	3.18
D 8	BUS 87	-41.78	4.18
	Total:	-10.00	18.88
D 11	D 9	20.00	8.38
	Total:	20.00	8.38
D 13	D 12	20.00	7.02
	Total:	20.00	7.02
E 1	E 2	143.34	14.28
E 1	E 6	53.38	18.87
E 1	BUS 102	33.31	27.33
	Total:	230.00	71.88
E 2	E 1	-138.78	-8.48
E 2	E 3	88.78	18.01
E 2	E 4	40.88	12.58
E 2	E 6	20.82	14.07
E 2	BUS 87	30.80	.12

E 3	E 2	-63.71	-11.65
E 3	E 4	-30.49	4.47
Total:		-84.20	-7.18
E 5	E 11	8.38	4.78
E 6	E 12	7.85	2.65
E 6	E 13	18.30	7.67
E 6	E 8	-45.60	-8.82
Total:		-11.20	6.46
E 8	E 7	.00	15.83
Total:		.00	15.83
BUS 2	BUS 1	13.22	7.80
BUS 2	BUS 12	-33.22	-15.80
Total:		-20.00	-8.00
BUS 3	BUS 1	36.07	3.84
BUS 3	BUS 6	-77.33	-11.25
BUS 3	BUS 12	-10.74	-12.59
Total:		-50.00	-20.00
BUS 5	BUS 4	51.64	21.85
BUS 6	BUS 3	75.85	15.52
BUS 6	BUS 8	108.55	-1.26
BUS 6	BUS 11	84.51	-.06
BUS 5	BUS 8	-387.42	-63.81
BUS 5	BUS 5	.00	40.05
Total:		-40.00	-15.00
BUS 7	BUS 6	-53.45	-3.54
BUS 7	BUS 12	2.45	-10.45
Total:		-51.00	-14.00
BUS 8	BUS 5	445.22	30.47
BUS 8	BUS 10	-445.22	-30.47
Total:		.00	.00
BUS 11	BUS 4	-75.83	5.15
BUS 11	BUS 6	-83.15	3.22
BUS 11	BUS 12	51.75	-42.20
BUS 11	BUS 13	37.03	10.80
Total:		-70.00	-23.00
BUS 13	BUS 11	-36.85	-11.45
BUS 13	BUS 15	2.85	-4.55
Total:		-34.00	-15.00
BUS 14	BUS 12	-10.25	-5.75
BUS 14	BUS 15	5.25	1.75
Total:		-14.00	-5.00
BUS 15	BUS 12	-5.07	-5.25
BUS 15	BUS 17	-15.83	-3.74
Total:		-25.00	-10.00
BUS 17	BUS 15	105.64	25.25
BUS 17	BUS 16	17.07	-.25
BUS 17	BUS 18	82.23	23.75
BUS 17	BUS 21	5.40	12.85
BUS 17	BUS 113	.85	5.32
BUS 17	BUS 20	-229.12	-71.01
BUS 17	BUS 17	.00	.00
Total:		-11.00	-3.00
BUS 20	BUS 19	15.35	34.03
BUS 20	BUS 21	22.10	12.85
BUS 20	B 1	-55.50	-83.85
Total:		-18.00	-7.00
BUS 21	BUS 20	-21.65	-14.55
BUS 21	BUS 22	-20.81	10.77
BUS 21	B 4	-1.21	-11.15
Total:		-44.00	-15.00
BUS 22	BUS 21	20.83	-12.65
BUS 22	BUS 23	-85.87	25.01
BUS 22	B 5	21.04	-25.35
Total:		-45.00	-13.00

BUS 23	BUS 23	89.85	-18.58
BUS 23	BUS 24	-82.82	12.41
BUS 23	BUS 25	-175.74	-27.89
BUS 23	BUS 32	78.45	3.77
Total:		-82.00	-28.00

BUS 26	BUS 27	-43.08	.90
BUS 26	BUS 29	26.98	-7.90
Total:		-17.00	-7.00

BUS 28	BUS 28	-25.88	8.14
BUS 28	BUS 31	1.88	-20.14
Total:		-24.00	-14.00

BUS 30	BUS 8	-112.55	-70.32
BUS 30	BUS 26	-222.41	-35.77
BUS 30	BUS 38	105.83	12.83
BUS 30	BUS 17	229.12	93.67
Total:		.00	.00

BUS 33	BUS 15	-13.95	4.33
BUS 33	BUS 37	-9.35	-13.33
Total:		-23.00	-9.00

BUS 35	BUS 36	1.03	-.59
BUS 35	BUS 37	-34.03	-18.41
Total:		-33.00	-19.00

BUS 37	BUS 35	34.20	17.85
BUS 37	BUS 33	9.45	10.13
BUS 37	BUS 34	89.85	33.85
BUS 37	BUS 39	50.70	5.22
BUS 37	BUS 40	36.86	-1.25
BUS 37	BUS 38	-234.03	-80.58
BUS 37	BUS 37	.00	24.58
Total:		.00	.00

BUS 38	BUS 30	-105.25	-45.78
BUS 38	BUS 85	-126.78	-58.75
BUS 38	BUS 37	234.03	114.54
Total:		.00	.00

BUS 39	BUS 37	-49.85	-5.01
BUS 39	BUS 40	22.85	-5.99
Total:		-27.00	-11.00

BUS 41	BUS 40	-22.86	.18
BUS 41	BUS 42	-14.14	-10.18
Total:		-37.00	-10.00

BUS 43	BUS 44	-4.30	-10.82
BUS 43	BUS 34	-13.70	3.82
Total:		-18.00	-7.00

BUS 44	BUS 43	4.35	4.83
BUS 44	BUS 45	-44.48	.88
BUS 44	A 5	24.14	-3.55
BUS 44	BUS 44	.00	-10.27
Total:		-16.00	-8.00

BUS 45	BUS 44	44.92	-1.47
BUS 45	BUS 46	-81.23	-25.57
BUS 45	BUS 49	-50.85	17.78
BUS 45	A 2	-15.84	-25.27
BUS 45	BUS 45	.00	-10.45
Total:		-83.00	-45.00

BUS 47	BUS 48	2.98	-48.21
BUS 47	BUS 46	-27.83	8.14
BUS 47	BUS 88	-39.98	7.07
Total:		-84.00	-30.00

BUS 48	BUS 45	-.01	-28.04
BUS 48	BUS 46	-37.38	42.04
BUS 48	A 1	17.40	-11.81
BUS 48	BUS 48	.00	-18.18
Total:		-20.00	-11.00

BUS 50	BUS 49	-38.18	-11.85
BUS 50	BUS 87	18.18	7.85
Total:		-17.00	-4.00

BUS 51	BUS 48	-38.08	-18.98
BUS 51	BUS 52	28.88	7.87

IS 81	D 4	-15.73	-5.32
	Total:	-17.00	-5.00
IS 82	BUS 81	-25.70	-5.87
IS 82	BUS 83	7.70	3.87
	Total:	-18.00	-5.00
IS 83	BUS 82	-7.88	-7.82
IS 83	BUS 84	-15.24	-3.48
	Total:	-23.00	-11.00
IS 87	BUS 85	5.88	7.84
IS 87	BUS 80	-18.87	-10.84
	Total:	-12.00	-3.00
IS 88	BUS 88	-1.08	3.85
IS 88	BUS 81	-10.82	-6.85
	Total:	-12.00	-3.00
IS 80	BUS 88	28.88	-4.81
IS 80	BUS 81	-110.88	-21.10
IS 80	BUS 82	2.80	-17.00
	Total:	-78.00	-43.00
IS 83	BUS 84	-118.03	-88.88
IS 83	BUS 88	118.03	88.88
	Total:	.00	.00
IS 84	BUS 83	118.38	82.08
IS 84	BUS 85	-152.53	-86.81
IS 84	BUS 81	34.18	18.88
	Total:	.00	.00
IS 87	BUS 82	-.71	14.82
IS 87	BUS 88	-88.46	-17.88
IS 87	D 8	42.18	-4.07
	Total:	-28.00	-7.00
JS 88	BUS 88	-82.28	-30.88
JS 88	BUS 81	-118.73	38.10
JS 88	BUS 118	184.18	-108.38
JS 88	BUS 88	-2.18	103.88
	Total:	.00	.00
JS 71	BUS 70	84.84	-7.88
JS 71	BUS 72	-27.87	8.48
JS 71	BUS 73	-38.88	-1.82
	Total:	.00	.00
JS 75	BUS 70	-21.81	-.87
JS 75	BUS 88	-78.88	-21.88
JS 75	BUS 74	34.42	-8.88
JS 75	BUS 77	-48.85	-1.03
JS 75	BUS 118	28.80	8.82
	Total:	-80.00	-25.00
JS 78	BUS 77	-33.78	-10.84
JS 78	BUS 78	-37.24	-15.17
	Total:	-71.00	-28.00
US 78	BUS 78	37.33	14.80
US 78	BUS 80	-78.33	-26.53
US 78	BUS 78	.00	-20.37
	Total:	-28.00	-32.00
US 81	BUS 88	120.03	-88.52
US 81	BUS 80	-120.03	88.53
	Total:	.00	.00
US 82	BUS 77	46.87	-18.30
US 82	BUS 83	-41.77	.82
US 82	BUS 88	-34.45	5.08
US 82	C 28	-22.82	8.74
US 82	BUS 82	.00	-20.14
	Total:	-54.00	-27.00
US 83	BUS 82	41.87	-1.15
US 83	BUS 84	-18.88	3.71
US 83	BUS 85	-32.42	.87
US 83	C 8	-8.87	-2.48
US 83	BUS 83	.00	-10.18
	Total:	-20.00	-10.00

BUS 84	BUS 82	20.08	-5.82
BUS 84	BUS 85	-31.08	-1.18
Total:		-11.00	-7.00
BUS 85	BUS 85	-17.01	4.82
BUS 85	BUS 87	-3.85	-14.82
Total:		-21.00	-10.00
BUS 89	BUS 85	55.15	-8.27
BUS 88	BUS 86	-104.15	-18.73
Total:		-48.00	-25.00
BUS 83	BUS 82	-47.83	-5.40
BUS 83	BUS 84	35.83	-.60
Total:		-12.00	-7.00
BUS 94	BUS 92	-41.72	-3.88
BUS 84	BUS 83	-35.28	-.42
BUS 84	BUS 85	51.88	2.03
BUS 84	BUS 85	43.34	-11.82
BUS 84	BUS 100	-48.34	-1.81
Total:		-30.00	-15.00
BUS 86	BUS 84	-51.53	-1.88
BUS 85	BUS 86	28.85	-20.03
BUS 86	C 4	-17.32	-8.88
Total:		-42.00	-31.00
BUS 85	BUS 80	2.32	-21.71
BUS 85	BUS 82	34.87	-5.11
BUS 88	BUS 84	-42.81	11.20
BUS 88	BUS 85	-26.78	18.18
BUS 88	BUS 87	-5.42	-17.52
Total:		-38.00	-15.00
BUS 87	BUS 80	9.84	-23.84
BUS 87	BUS 88	5.47	15.31
BUS 87	E 2	-30.31	-.57
Total:		-15.00	-9.00
BUS 88	BUS 80	-15.81	-43.53
BUS 86	BUS 100	-48.08	-4.47
Total:		-64.00	-48.00
BUS 101	BUS 100	2.23	.51
BUS 101	BUS 102	-24.23	-15.51
Total:		-22.00	-15.00
BUS 102	BUS 82	-15.35	20.85
BUS 102	BUS 101	24.41	13.33
BUS 102	E 1	-33.08	-36.88
Total:		-25.00	-3.00
BUS 105	BUS 103	-31.11	-11.78
BUS 105	BUS 104	-22.84	-8.53
BUS 105	BUS 105	15.85	8.21
BUS 105	BUS 107	-5.59	-8.46
BUS 105	BUS 108	8.75	8.15
BUS 105	BUS 105	.00	-18.53
Total:		-31.00	-34.00
BUS 108	BUS 100	-38.82	-18.03
BUS 106	BUS 105	-15.82	-8.25
BUS 106	BUS 107	-11.28	-10.88
Total:		-88.00	-36.00
BUS 108	BUS 105	-8.71	-7.74
BUS 108	BUS 108	7.71	8.74
Total:		-2.00	-1.00
BUS 108	BUS 108	-7.70	-7.40
BUS 108	BUS 110	-40.30	-2.80
Total:		-48.00	-10.00
BUS 110	BUS 103	-14.24	-15.11
BUS 110	BUS 108	40.80	2.10
BUS 110	BUS 111	-35.70	-5.51
BUS 110	BUS 112	-29.77	.05
BUS 110	BUS 110	.00	-5.82
Total:		-39.00	-25.10

Total:		-8.00	8.40
BUS 114	BUS 32	-3.87	-8.78
BUS 114	BUS 115	-16.13	8.78
Total:		-20.00	-3.00
BUS 115	BUS 27	-51.14	-3.00
BUS 115	BUS 114	16.14	-7.00
Total:		-35.00	-10.00
BUS 117	BUS 12	-20.00	-8.00
Total:		-20.00	-8.00
BUS 118	BUS 75	-29.65	-8.16
BUS 118	BUS 79	-3.35	-5.84
Total:		-33.00	-15.00
A 3	A 1	-44.96	-7.13
A 3	A 4	42.46	5.93
Total:		-2.40	-1.20
A 4	A 2	-33.74	-12.46
A 4	A 3	-42.23	-8.57
A 4	A 6	43.23	.61
A 4	A 12	25.14	19.81
Total:		-7.60	-1.60
A 6	A 2	-43.20	-11.33
A 6	A 4	-43.01	-.50
A 6	A 7	8.58	1.68
A 6	A 8	32.65	1.52
A 6	A 28	21.28	11.78
A 6	A 9	11.69	-4.13
A 9	A 10	10.87	.88
Total:		.00	.00
A 7	A 5	-13.23	-5.63
A 7	A 8	-8.67	-4.27
Total:		-22.90	-10.90
A 8	A 11	-20.00	-7.58
A 8	A 10	31.88	3.15
A 8	A 6	-11.68	4.44
Total:		.00	.00
A 10	A 9	-31.68	-2.11
A 10	A 20	8.70	3.87
A 10	A 17	4.68	4.81
A 10	A 21	15.47	8.83
A 10	A 22	7.40	3.70
A 10	A 8	-10.87	-.38
A 10	A 10	.00	-20.21
Total:		-5.80	-2.00
A 12	A 13	-20.00	-4.18
A 12	A 14	8.01	2.84
A 12	A 15	16.33	8.78
A 12	A 16	7.58	2.87
A 12	A 4	-25.14	-14.83
Total:		-11.20	-7.60
A 14	A 12	-7.83	-2.38
A 14	A 15	1.73	.78
Total:		-6.20	-1.60
A 15	A 12	-16.11	-6.38
A 15	A 14	-1.73	-.77
A 15	A 16	8.35	1.74
A 15	A 23	8.28	1.87
Total:		-6.20	-2.60
A 16	A 12	-7.53	-2.85
A 16	A 17	4.03	1.05
Total:		-3.50	-1.80
A 17	A 16	-4.02	-1.02
A 17	A 10	-4.98	-4.78
Total:		-9.00	-5.80
A 18	A 15	-8.30	-1.85
A 18	A 19	3.10	.75

	Total:	-3.20	-.80
A 18	A 16	-3.16	-.74
A 18	A 20	-6.40	-2.66
	Total:	-9.60	-3.40
A 20	A 18	5.42	2.66
A 20	A 10	-6.82	-3.36
	Total:	-2.20	-.70
A 21	A 10	-16.37	-8.41
A 21	A 22	-2.13	-2.78
	Total:	-17.60	-11.20
A 22	A 10	-7.36	-3.60
A 22	A 21	2.14	2.80
A 22	A 24	5.22	.81
	Total:	.00	.00
A 23	A 16	-5.26	-1.81
A 23	A 24	2.06	.21
	Total:	-3.20	-1.60
A 24	A 22	-5.16	-.76
A 24	A 23	-2.06	-.20
A 24	A 26	-1.46	-1.63
A 24	A 24	.00	-4.11
	Total:	-8.70	-8.70
A 26	A 24	1.46	1.66
A 26	A 26	3.54	2.37
A 26	A 27	-5.00	-4.01
	Total:	.00	.00
A 26	A 26	-3.50	-2.30
	Total:	-3.50	-2.30
A 27	A 26	6.04	4.10
A 27	A 29	4.34	1.66
A 27	A 30	5.66	2.16
A 27	A 28	-14.96	-7.66
	Total:	.00	.00
A 28	A 8	-21.16	-12.06
A 28	A 6	.40	-4.26
A 28	BUS 42	6.46	7.36
A 28	A 27	14.66	6.66
	Total:	.00	.00
A 29	A 27	-4.31	-1.64
A 29	A 30	1.81	.66
	Total:	-2.40	-.60
A 30	A 27	-6.50	-2.03
A 30	A 26	-1.60	-.67
	Total:	-7.40	-2.70
B 3	B 1	-20.66	-13.61
B 3	B 4	18.66	12.41
	Total:	-2.40	-1.20
B 4	B 2	-19.64	-16.62
B 4	B 3	-16.60	-13.66
B 4	B 5	7.66	2.76
B 4	BUS 21	1.23	6.66
B 4	B 13	21.66	17.06
	Total:	-7.60	-1.60
B	B 2	-21.36	-16.46
B	B 4	-7.66	-3.16
B	B 7	30.11	-2.20
B	B 6	-11.63	-1.77
B	B 26	-12.63	26.47
B	B 8	12.30	-2.90
B	B 10	11.04	1.46
	Total:	.00	.00
B 7	B 5	7.07	-11.14
B 7	B 6	-26.37	.24
	Total:	-22.60	-10.90
B	B 11	-20.00	-6.22

B 8	B 10	32.30	3.00
B 8	B 6	-12.30	3.21
Total:		.00	.00
B 10	B 8	-32.30	-1.83
B 10	B 20	8.32	3.54
B 10	B 17	8.28	4.73
B 10	B 21	14.80	8.81
B 10	B 22	7.04	3.88
B 10	B 8	-11.04	-.81
B 10	B 10	.00	-20.33
Total:		-5.80	-2.00
B 12	B 13	-20.00	-3.87
B 12	B 14	7.57	2.56
B 12	B 18	10.80	5.85
B 12	B 16	8.28	3.02
B 12	B 4	-21.85	-15.38
Total:		-11.20	-7.50
B 14	B 12	-7.48	-2.43
B 14	B 15	1.28	.83
Total:		-6.20	-1.60
B 15	B 12	-10.80	-5.57
B 15	B 14	-1.28	-.82
B 15	B 18	5.73	1.77
B 15	B 23	3.87	2.13
Total:		-6.20	-2.50
B 18	B 12	-8.24	-2.83
B 18	B 17	2.74	1.13
Total:		-3.50	-1.50
B 17	B 18	-2.73	-1.11
B 17	B 10	-8.27	-4.68
Total:		-8.00	-5.80
B 18	B 15	-5.68	-1.70
B 18	B 16	2.48	.80
Total:		-3.20	-.80
B 19	B 18	-2.48	-.78
B 19	B 20	-7.01	-2.61
Total:		-8.50	-3.40
B 20	B 18	7.03	2.85
B 20	B 10	-8.23	-3.35
Total:		-2.20	-.70
B 21	B 10	-14.81	-8.70
B 21	B 22	-2.68	-2.50
Total:		-17.50	-11.20
B 22	B 10	-8.88	-3.80
B 22	B 21	2.70	2.51
B 22	B 24	4.30	1.28
Total:		.00	.00
B 23	B 15	-3.85	-2.08
B 23	B 24	.75	.48
Total:		-3.20	-1.80
B 24	B 22	-4.27	-1.28
B 24	B 23	-.75	-.48
B 24	B 25	-3.86	-.82
B 24	B 24	.00	-4.13
Total:		-8.70	-8.70
B 25	B 24	3.71	.87
B 25	B 26	3.54	2.37
B 25	B 27	-7.24	-3.24
Total:		.00	.00
B 25	B 25	-3.50	-2.30
Total:		-3.50	-2.30
B 27	B 25	7.31	3.38
B 27	B 26	4.34	1.85
B 27	B 30	6.58	2.15
B 27	B 26	-17.21	-7.18
Total:		.00	.00

B 28	B 8	12.78	-26.84
B 28	B 8	1.10	-8.88
B 28	BUS 32	-31.07	28.17
B 28	B 27	17.21	8.43
	Total:	.00	.00
B 28	B 27	-4.31	-1.58
B 28	B 30	1.91	.88
	Total:	-2.40	-.80
B 30	B 27	-5.50	-2.02
B 30	B 28	-1.90	-.67
	Total:	-7.40	-2.70
C 3	C 1	-43.38	-7.51
C 3	C 4	40.98	6.31
	Total:	-2.40	-1.20
C 4	C 2	-43.77	-8.37
C 4	C 3	-40.77	-7.00
C 4	C 5	34.65	-10.67
C 4	BUS 95	17.38	5.28
C 4	C 12	24.70	18.18
	Total:	-7.80	-1.80
C 6	C 2	-51.15	-4.75
C 6	C 4	-34.88	10.75
C 6	C 7	8.25	5.81
C 6	C 8	24.53	-10.36
C 6	C 28	32.87	-.01
C 6	C 9	12.14	-2.84
C 6	C 10	10.85	1.43
	Total:	.00	.00
C 7	C 5	-17.57	-2.45
C 7	C 6	-5.23	-8.45
	Total:	-22.80	-10.80
C 8	C 11	-20.00	-8.84
C 8	C 10	32.14	2.80
C 8	C 6	-12.14	3.14
	Total:	.00	.00
: 10	C 8	-32.14	-1.73
: 10	C 20	8.68	3.76
: 10	C 17	5.23	5.27
: 10	C 21	15.87	8.34
: 10	C 22	7.53	3.51
: 10	C 6	-10.85	-.80
: 10	C 10	.00	-20.38
	Total:	-5.80	-2.00
: 12	C 13	-20.00	-3.30
: 12	C 14	7.87	2.37
: 12	C 15	18.18	5.21
: 12	C 18	7.35	2.50
: 12	C 4	-24.70	-14.28
	Total:	-11.20	-7.50
14	C 12	-7.88	-2.21
14	C 15	1.68	.61
	Total:	-6.20	-1.60
15	C 12	-17.87	-4.78
15	C 14	-1.89	-.80
15	C 18	8.19	1.53
15	C 23	5.27	1.35
	Total:	-6.20	-2.50
18	C 12	-7.28	-2.39
18	C 17	3.78	.59
	Total:	-3.50	-1.80
17	C 18	-3.76	-.58
17	C 10	-5.22	-5.24
	Total:	-8.00	-5.80
18	C 15	-8.15	-1.44
18	C 18	2.95	.84
	Total:	-3.20	-.80
19	C 16	-2.94	-.53
19	C 20	-8.58	-2.87
	Total:	-9.50	-3.40

C 20	C 19	8.58	2.80
C 20	C 10	-8.78	-3.50
Total:		-2.20	-.70
C 21	C 10	-15.57	-8.12
C 21	C 22	-1.93	-3.08
Total:		-17.50	-11.20
C 22	C 10	-7.49	-3.41
C 22	C 21	1.93	3.09
C 22	C 24	5.55	.32
Total:		.00	.00
C 23	C 15	-5.24	-1.30
C 23	C 24	2.04	-.30
Total:		-3.20	-1.60
C 24	C 22	-5.52	-.27
C 24	C 23	-2.04	.31
C 24	C 25	-1.14	-2.60
C 24	C 24	.00	-4.14
Total:		-8.70	-6.70
C 25	C 24	1.15	2.63
C 25	C 28	3.54	2.37
C 25	C 27	-4.69	-4.69
Total:		.00	.00
C 28	C 25	-3.50	-2.30
Total:		-3.50	-2.30
C 27	C 25	4.74	5.06
C 27	C 29	4.34	1.65
C 27	C 30	5.56	2.15
C 27	C 26	-14.65	-8.86
Total:		.00	.00
C 28	C 8	-32.78	.00
C 28	C 8	-4.75	-3.01
C 28	BUS 62	22.69	-9.63
C 28	C 27	14.85	5.94
Total:		.00	.00
C 29	C 27	-4.31	-1.56
C 29	C 30	1.91	.66
Total:		-2.40	-.90
C 30	C 27	-5.50	-2.03
C 30	C 29	-1.90	-.67
Total:		-7.40	-2.70
D 3	D 1	-6.26	-8.23
D 3	D 4	5.86	7.02
Total:		-2.40	-1.20
D 4	D 2	-21.25	-7.14
D 4	D 3	-9.84	-8.29
D 4	D 8	-15.02	-3.68
D 4	BUS 51	15.88	3.57
D 4	D 12	20.85	13.83
Total:		-7.80	-1.80
D 6	D 2	-17.22	-8.60
D 6	D 4	18.05	3.24
D 6	D 7	-7.83	7.85
D 6	D 8	-24.22	-8.63
D 6	D 28	7.77	7.80
D 6	D 9	13.52	-4.01
D 6	D 10	11.73	1.04
Total:		.00	.00
D 7	D 5	-30.47	-.39
D 7	D 9	7.67	-10.51
Total:		-22.80	-10.90
D 8	D 11	-20.00	-7.48
D 8	D 10	33.52	3.09
D 8	D 9	-13.52	4.40
Total:		.00	.00
D 10	D 9	-33.52	-1.89

D 10	D 20	8.73	3.50
D 10	D 17	6.67	4.70
D 10	D 21	15.40	6.59
D 10	D 22	7.36	3.67
D 10	D 6	-11.73	-.32
D 10	D 10	.00	-20.23
Total:		-5.50	-2.00
D 12	D 13	-20.00	-8.45
D 12	D 14	7.45	2.54
D 12	D 15	16.40	5.83
D 12	D 18	5.50	3.03
D 12	D 4	-20.85	-12.45
Total:		-11.20	-7.60
D 14	D 12	-7.38	-2.38
D 14	D 15	1.18	.78
Total:		-6.20	-1.60
D 15	D 12	-1,.21	-5.47
D 15	D 14	-1.18	-.78
D 15	D 16	5.32	1.82
D 15	D 22	3.88	1.84
Total:		-8.20	-2.60
D 16	D 12	-5.88	-2.86
D 16	D 17	2.08	1.18
Total:		-3.80	-1.80
D 17	D 16	-2.08	-1.18
D 17	D 10	-6.84	-4.85
Total:		-9.00	-5.80
D 18	D 15	-5.28	-1.75
D 18	D 19	2.08	.85
Total:		-3.20	-.60
D 19	D 18	-2.08	-.85
D 19	D 20	-7.42	-2.55
Total:		-9.50	-3.40
D 20	D 19	7.44	2.59
D 20	D 10	-9.64	-3.29
Total:		-2.20	-.70
D 21	D 10	-15.28	-8.38
D 21	D 22	-2.21	-2.84
Total:		-17.50	-11.20
D 22	D 10	-7.31	-3.57
D 22	D 21	2.21	2.84
D 22	D 24	5.10	.73
Total:		.00	.00
D 23	D 19	-3.68	-1.90
D 23	D 24	.88	.30
Total:		-3.20	-1.60
D 24	D 22	-5.07	-.88
D 24	D 23	-.88	-.30
D 24	D 28	-2.87	-1.80
D 24	D 24	.00	-4.11
Total:		-8.70	-8.70
D 25	D 24	2.88	1.84
D 25	D 28	3.54	2.37
D 25	D 27	-6.52	-4.00
Total:		.00	.00
D 26	D 25	-3.50	-2.30
Total:		-3.50	-2.30
D 27	D 25	8.56	4.12
D 27	D 28	4.34	1.65
D 27	D 30	5.68	2.15
D 27	D 26	-18.48	-7.92
Total:		.00	.00
D 28	D 8	-7.75	-8.48
D 28	D 8	-7.45	-5.18
D 28	BUS_59	-1.30	4.80
D 28	D 27	18.48	9.14
Total:		.00	.00

D 28	D 27	-4.31	-1.58
D 28	D 30	1.81	.68
+			
	Total:	-2.40	-.80
D 30	D 27	-5.50	-2.03
D 30	D 28	-1.80	-.67
+			
	Total:	-7.40	-2.70
E 4	E 2	-38.81	-13.18
E 4	E 3	31.17	-8.01
E 4	E 5	-81.58	7.85
E 4	E 7	27.03	-8.64
E 4	E 8	15.48	-.23
+			
	Total:	-47.80	-20.00
E 5	E 1	-1.73	-18.47
E 5	E 2	-20.45	-18.41
E 5	E 4	82.52	-8.25
E 5	BUS 80	-93.74	27.73
E 5	E 6	45.80	11.81
+			
	Total:	-7.80	-1.80
E 7	E 8	.00	-15.43
E 7	E 9	27.03	5.23
E 7	E 4	-27.03	10.20
+			
	Total:	.00	.00
E 8	E 7	-27.03	-4.43
E 8	E 10	4.27	3.10
E 8	E 14	8.78	2.81
E 8	E 4	-15.48	1.53
E 8	E 8	.00	-18.70
+			
	Total:	-29.50	-16.80
E 10	E 9	-4.25	-3.07
E 10	E 11	-4.74	-2.73
+			
	Total:	-9.00	-5.80
E 11	E 9	-6.29	-4.58
E 11	E 10	4.75	2.78
+			
	Total:	-3.50	-1.80
E 12	E 8	-7.68	-2.48
E 12	E 13	1.78	.68
+			
	Total:	-9.10	-1.80
E 13	E 9	-15.06	-7.38
E 13	E 12	-1.77	-.87
E 13	E 14	8.32	2.47
+			
	Total:	-13.50	-5.80
E 14	E 8	-6.85	-2.68
E 14	E 13	-8.25	-2.31
	Total:	-14.80	-5.00

System losses:	151.35	-588.68
R*I**2,X*I**2:	151.35	884.48

Appendix H

250 Bus Network

Base Case B

H.1 Bus Oriented Results

H.2 Line Flow Results

```
    Time for input:  3.27
    Time for compact:   .28
    Time for factorization:   .33
No. of iterations: 34
Maximum mismatch (in pu):  9.0E-05 9.7E-04
    Time for solution:   .95
Execution time:  4.82

S base : 100.
```

Bus	Vsp	Voltage		Generation		QGmin	QGmax	Load	
BUS 69		1.035	30.00	328.40	-50.35				
BUS 1	.960	.950-	5.32	.00	35.00	-5.00	35.00	63.75	37.80
BUS 4	.998	.998	12.46	50.00	33.15	-300.00	300.00	37.50	16.80
BUS 6	.990	.983-	8.55	.00	50.00	-13.00	50.00	65.00	30.80
BUS 8	1.015	1.015	20.06	40.00	224.63	-300.00	300.00	.00	14.00
BUS 10	1.055	1.055	39.07	570.00	60.69	-147.00	200.00	.00	.00
BUS 12	.990	.978-	7.56	85.00	120.00	-35.00	120.00	58.75	28.00
BUS 15	.970	.970	6.57	.00	46.58	-10.00	50.00	112.50	56.00
BUS 18	.973	.973	6.83	.00	37.58	-16.00	50.00	75.00	47.60
BUS 19	.960	.968+	5.90	.00	-8.00	-8.00	24.00	56.25	35.00
BUS 24	.992	.992	19.97	49.00	12.48	-300.00	300.00	.00	.00
BUS 25	1.050	1.050	26.49	220.00	86.27	-47.00	140.00	.00	.00
BUS 26	1.015	1.015	29.67	420.00	23.26	-1000.00	1000.00	.00	.00
BUS 27	.968	.968	12.49	45.00	12.44	-300.00	300.00	25.00	18.20
BUS 31	.967	.967	7.95	7.00	63.97	-300.00	300.00	53.75	37.80
BUS 32	.963	.963	9.66	.00	26.25	-14.00	42.00	73.75	32.20
BUS 34	.984	.984	9.02	.00	15.02	-8.00	24.00	73.75	36.40
BUS 36	.980	.978-	8.51	.00	24.00	-8.00	24.00	38.75	23.80
BUS 40	.970	.970	8.03	.00	-7.71	-300.00	300.00	25.00	32.20
BUS 42	.985	.985	9.78	.00	37.15	-300.00	300.00	46.25	32.20
BUS 46	1.080	1.067-	17.42	89.00	100.00	-100.00	100.00	35.00	14.00
BUS 49	1.025	1.025	20.94	300.00	53.54	-85.00	210.00	108.75	42.00
BUS 54	.970	.970	15.49	48.00	39.89	-300.00	300.00	141.25	72.80
BUS 55	.970	.969-	15.20	.00	23.00	-8.00	23.00	78.75	30.80
BUS 56	.970	.972+	15.62	.00	-8.00	-8.00	15.00	105.00	53.20
BUS 59	.985	.985	18.37	155.00	109.68	-60.00	180.00	346.25	158.20
BUS 61	.995	.995	23.24	160.00	13.99	-100.00	300.00	.00	.00
BUS 62	.998	.996-	22.08	.00	30.00	-20.00	30.00	96.25	33.60
BUS 65	1.005	1.005	29.23	500.00	141.80	-67.00	200.00	.00	.00
BUS 66	1.050	1.050	27.31	500.00	28.21	-67.00	200.00	48.75	25.20
BUS 70	.984	.984	23.24	.00	17.43	-10.00	32.00	82.50	28.00
BUS 72	.980	.980	24.78	43.00	-23.32	-100.00	100.00	.00	.00
BUS 73	.991	.991	25.10	37.00	.95	-100.00	100.00	.00	.00
BUS 74	.975	.966-	20.89	.00	39.00	-6.00	39.00	85.00	37.80
BUS 76	.970	.970	21.54	.00	78.03	-8.00	80.00	85.00	51.80
BUS 77	1.006	1.006	29.99	.00	43.95	-20.00	70.00	76.25	28.00
BUS 80	1.040	1.040	34.01	600.00	218.21	-165.00	280.00	162.50	78.40
BUS 85	1.020	1.018-	37.07	.00	23.00	-8.00	23.00	30.00	21.00
BUS 87	1.015	1.015	35.93	4.00	-19.35	-100.00	1000.00	.00	.00
BUS 89	1.055	1.055	46.68	750.00	118.68	-210.00	300.00	.00	.00
BUS 90	.985	.985	40.59	.00	3.59	-300.00	300.00	97.50	72.80
BUS 91	.985	.985	42.03	20.00	-43.17	-100.00	100.00	.00	.00
BUS 92	1.030	1.030	41.79	.00	15.19	-3.00	20.00	81.25	28.00
BUS 99	1.015	1.015	38.65	35.00	-24.50	-100.00	100.00	.00	.00
BUS 100	1.017	1.017	38.74	350.00	86.22	-50.00	155.00	46.25	25.20

BUS 103	1.000	.999-	35.83	40.00	50.00	-15.00	50.00	28.75	22.40
BUS 104	.971	.971	32.79	.00	41.69	-8.00	53.00	47.50	35.00
BUS 107	.980	.980	31.85	45.00	35.21	-200.00	200.00	35.00	16.80
BUS 111	.980	.980	34.21	36.00	11.92	-100.00	1000.00	.00	.00
BUS 112	.975	.975	33.50	55.00	27.38	-100.00	1000.00	31.25	18.20
BUS 116	1.005	1.005	30.22	.00	88.91	-1000.00	1000.00	.00	.00
A 1	1.050	1.050	14.97	100.00	35.21	-100.00	100.00	.00	.00
A 2	1.045	1.033-	12.43	80.00	80.00	-20.00	80.00	27.13	17.78
A 5	1.010	.995-	7.86	50.00	62.45	-15.00	62.45	117.75	54.60
A 8	1.000	.989-	8.00	20.00	85.00	-15.00	85.00	37.50	42.00
A 11	1.050	1.050	8.62	20.00	16.03	-10.00	45.83	.00	.00
A 13	1.050	1.050	6.30	20.00	16.18	-15.00	56.57	.00	.00
B 1	1.050	1.050	4.09	100.00	98.75	-100.00	100.00	.00	.00
B 2	1.045	1.040-	2.92	80.00	60.00	-20.00	60.00	27.13	17.78
B 5	1.010	.998-	-2.51	50.00	62.45	-15.00	62.45	117.75	54.60
B 8	1.010	.991-	2.18	20.00	75.00	-15.00	75.00	37.50	42.00
B 11	1.050	1.050	1.58	20.00	16.24	-10.00	45.83	.00	.00
B 13	1.050	1.050	-1.06	20.00	17.03	-15.00	56.57	.00	.00
C 1	1.050	1.050	41.67	100.00	33.89	-100.00	100.00	.00	.00
C 2	1.045	1.045-	40.36	80.00	60.00	-20.00	60.00	27.13	17.78
C 5	1.010	1.010	35.84	50.00	50.08	-15.00	62.45	117.75	54.60
C 8	1.010	1.004-	33.72	20.00	75.00	-15.00	75.00	37.50	42.00
C 11	1.050	1.050	34.56	20.00	13.71	-10.00	45.83	.00	.00
C 13	1.050	1.050	32.42	20.00	14.48	-15.00	56.57	.00	.00
D 1	1.025	1.019-	18.17	100.00	100.00	-100.00	100.00	.00	.00
D 2	1.020	1.020	19.42	80.00	27.51	-20.00	60.00	27.13	17.78
D 5	1.010	1.010	22.24	50.00	32.89	-15.00	62.45	117.75	54.60
D 8	1.010	1.007-	18.84	20.00	75.00	-15.00	75.00	37.50	42.00
D 11	1.050	1.050	17.83	20.00	14.41	-10.00	45.83	.00	.00
D 13	1.050	1.050	14.91	20.00	16.72	-15.00	56.57	.00	.00
E 1	1.060	1.055-	41.78	300.00	90.00	-40.00	90.00	25.00	16.80
E 2	1.045	1.017-	36.49	40.00	50.00	-40.00	50.00	27.13	17.78
E 3	.970	.969-	27.50	.00	70.00	.00	70.00	117.75	54.60
E 6	1.040	1.037-	27.52	.00	34.00	-6.00	34.00	14.00	10.50
E 8	1.050	1.050	28.51	.00	23.98	-6.00	34.00	.00	.00

Bus	Voltage		Load	
BUS 2	.960	6.21	25.00	12.60
BUS 3	.955	6.63	62.50	28.00
BUS 5	.999	12.86	50.00	25.20
BUS 7	.977	7.72	63.75	19.60
BUS 9	1.028	29.45	.00	.00
BUS 1[illegible]	.974	8.57	87.50	32.20
BUS 13	.954	6.83	42.50	22.40
BUS 14	.971	6.79	17.50	7.00
BUS 16	.972	7.35	31.25	14.00
BUS 17	.994	9.95	13.75	4.20
BUS 20	1.011	3.73	22.50	9.80
BUS 21	.985	2.35	55.00	21.00
BUS 22	.973	4.37	56.25	18.20
BUS 23	.981	17.10	77.50	39.20
BUS 28	.957	9.87	21.25	9.80
BUS 29	.958	8.09	30.00	19.60
BUS 30	.980	16.97	.00	.00
BUS 33	.966	7.04	28.75	12.60
BUS 35	.977	8.55	41.25	26.60
BUS 37	.989	9.78	.00	.00
BUS 38	.956	15.61	.00	.00
BUS 39	.967	7.98	33.75	15.40
BUS 41	.964	7.57	46.25	14.00
BUS 43	.977	7.75	22.50	9.80
BUS 44	.994	9.01	20.00	11.20
BUS 45	1.000	12.32	103.75	63.00
BUS 47	1.014	19.71	80.00	42.00
BUS 48	1.033	18.70	25.00	15.40
BUS 50	1.003	18.85	21.25	5.60
BUS 51	.977	16.51	21.25	11.20
BUS 52	.964	15.40	22.50	7.00
BUS 53	.953	14.33	28.75	15.40
BUS 57	.981	16.52	15.00	4.20
BUS 58	.972	15.78	15.00	4.20
BUS 60	.986	22.18	97.50	60.20
BUS 63	.967	22.43	.00	.00
BUS 64	.982	24.57	.00	.00
BUS 67	1.013	21.83	35.00	9.80
BUS 68	1.001	30.24	.00	.00
BUS 71	.987	24.12	.00	.00
BUS 75	.966	22.38	100.00	35.00
BUS 78	1.000	29.78	88.75	36.40
BUS 79	1.004	30.46	48.75	44.80
BUS 81	.993	31.69	.00	.00
BUS 82	.993	32.71	67.50	37.80
BUS 83	.999	33.66	25.00	14.00
BUS 84	1.005	35.71	13.75	9.80
BUS 86	1.016	35.46	26.25	14.00
BUS 88	1.018	41.59	60.00	35.00
BUS 93	1.007	38.99	15.00	9.80
BUS 94	.998	37.02	37.50	22.40
BUS 95	.987	35.35	52.50	43.40
BUS 96	.995	34.23	47.50	21.00
BUS 97	1.012	34.70	18.75	12.60
BUS 98	.973	33.22	80.00	67.20
BUS 101	1.013	39.20	27.50	21.00

BUS 102	1.037	41.04	31.25	4.20
BUS 105	.957	32.05	38.75	47.60
BUS 106	.944	31.45	86.25	50.40
BUS 108	.947	31.19	2.50	1.40
BUS 109	.943	30.88	60.00	14.00
BUS 110	.962	32.73	48.75	35.14
BUS 113	.992	9.74	7.50	-8.96
BUS 114	.954	9.52	25.00	4.20
BUS 115	.953	9.66	43.75	14.00
BUS 117	.955	5.61	25.00	11.20
BUS 118	.959	21.43	41.25	21.00
A 3	1.006	10.32	3.00	1.68
A 4	.996	9.40	9.50	2.24
A 6	.991	8.56	.00	.00
A 7	.981	7.55	28.50	15.26
A 9	1.019	6.39	.00	.00
A 10	1.007	4.01	7.25	2.80
A 12	1.029	4.82	14.00	10.50
A 14	1.007	3.72	7.75	2.24
A 15	1.002	3.59	10.25	3.50
A 16	1.010	4.16	4.38	2.52
A 17	1.002	3.84	11.25	8.12
A 18	.988	2.82	4.00	1.26
A 19	.983	2.62	11.88	4.76
A 20	.988	2.89	2.75	.98
A 21	.991	3.46	21.88	15.68
A 22	.993	3.49	.00	.00
A 23	.989	3.17	4.00	2.24
A 24	.982	3.06	10.88	9.38
A 25	.994	3.61	.00	.00
A 26	.972	3.02	4.38	3.22
A 27	1.013	4.28	.00	.00
A 28	.983	8.68	.00	.00
A 29	.997	3.52	3.00	1.26
A 30	.990	3.18	9.25	3.78
B 3	1.004	2.05	3.00	1.68
B 4	.995	1.71	9.50	2.24
B 6	.990	1.58	.00	.00
B 7	.982	-.70	28.50	15.26
B 9	1.019	-.65	.00	.00
B 10	1.007	-3.06	7.25	2.80
B 12	1.028	-2.55	14.00	10.50
B 14	1.006	-3.60	7.75	2.24
B 15	1.001	-3.68	10.25	3.50
B 16	1.009	-3.08	4.38	2.52
B 17	1.001	-3.28	11.25	8.12
B 18	.987	-4.38	4.00	1.26
B 19	.982	-4.54	11.88	4.76
B 20	.987	-4.24	2.75	.98
B 21	.991	-3.59	21.88	15.68
B 22	.992	-3.55	.00	.00
B 23	.987	-3.95	4.00	2.24
B 24	.980	-3.87	10.88	9.38
B 25	.992	-2.85	.00	.00
B 26	.970	-3.45	4.38	3.22
B 27	1.011	-1.91	.00	.00
B 28	.978	2.89	.00	.00
B 29	.994	-2.67	3.00	1.26
B 30	.987	-3.02	9.25	3.78
C 3	1.007	36.65	3.00	1.68

C 4	.998	35.65	9.50	2.24
C 6	.999	34.52	.00	.00
C 7	.992	34.29	28.50	15.26
C 9	1.024	32.35	.00	.00
C 10	1.012	29.97	7.25	2.80
C 12	1.031	30.94	14.00	10.50
C 14	1.010	29.80	7.75	2.24
C 15	1.005	29.64	10.25	3.50
C 16	1.014	30.21	4.38	2.52
C 17	1.006	29.82	11.25	8.12
C 18	.991	28.85	4.00	1.26
C 19	.987	28.63	11.88	4.76
C 20	.992	28.89	2.75	.98
C 21	.996	29.39	21.88	15.68
C 22	.998	29.40	.00	.00
C 23	.992	29.11	4.00	2.24
C 24	.987	28.84	10.88	9.38
C 25	1.000	28.94	.00	.00
C 26	.978	28.36	4.38	3.22
C 27	1.019	29.34	.00	.00
C 28	.992	33.32	.00	.00
C 29	1.003	28.59	3.00	1.26
C 30	.996	28.24	9.25	3.78
D 3	.997	17.51	3.00	1.68
D 4	.992	17.46	9.50	2.24
D 6	.996	18.02	.00	.00
D 7	.990	18.87	28.50	15.26
D 9	1.022	15.61	.00	.00
D 10	1.011	13.11	7.25	2.80
D 12	1.028	13.42	14.00	10.50
D 14	1.007	12.38	7.75	2.24
D 15	1.003	12.31	10.25	3.50
D 16	1.012	12.97	4.38	2.52
D 17	1.005	12.86	11.25	8.12
D 18	.989	11.68	4.00	1.26
D 19	.985	11.55	11.88	4.76
D 20	.991	11.87	2.75	.98
D 21	.995	12.54	21.88	15.68
D 22	.996	12.56	.00	.00
D 23	.990	12.01	4.00	2.24
D 24	.985	12.06	10.88	9.38
D 25	.999	12.68	.00	.00
D 26	.978	12.09	4.38	3.22
D 27	1.020	13.39	.00	.00
D 28	.990	17.84	.00	.00
D 29	1.003	12.63	3.00	1.26
D 30	.996	12.29	9.25	3.78
E 4	.967	32.47	59.75	28.00
E 5	.979	35.36	9.50	2.24
E 7	1.010	28.51	.00	.00
E 9	.997	26.44	36.88	23.24
E 10	.994	26.27	11.25	8.12
E 11	1.010	26.74	4.38	2.52
E 12	1.016	26.37	7.63	2.24
E 13	1.007	26.28	16.88	8.12
E 14	.977	25.01	18.63	7.00

Power Generated:	7081.40	3569.54
Power Demanded:	6836.00	3605.14
System Losses:	245.40	-35.60

BUS 58	BUS 47	85.58	-8.86
BUS 58	BUS 48	48.20	-12.12
BUS 58	BUS 70	88.86	21.88
BUS 88	BUS 75	117.58	24.87
BUS 88	BUS 77	8.40	25.45
BUS 88	BUS 88	-12.37	-100.37
Total:		326.40	-80.38
BUS 1	BUS 2	-15.71	-8.01
BUS 1	BUS 3	-48.04	3.20
Total:		-63.75	-2.81
BUS 4	BUS 5	-88.72	8.23
BUS 4	BUS 11	88.22	7.12
Total:		12.81	18.35
BUS 8	BUS 5	-135.15	5.55
BUS 8	BUS 7	70.15	13.83
Total:		-88.00	18.18
BUS 8	BUS 9	-554.84	21.11
BUS 8	BUS 30	111.78	38.81
BUS 8	BUS 8	483.16	152.62
Total:		40.00	210.83
BUS 10	BUS 8	570.00	80.88
Total:		570.00	80.88
BUS 12	BUS 11	-71.84	43.88
BUS 12	BUS 2	41.18	18.38
BUS 12	BUS 3	12.88	8.87
BUS 12	BUS 7	-8.18	8.88
BUS 12	BUS 14	18.48	3.28
BUS 12	BUS 18	8.75	8.08
BUS 12	BUS 117	28.28	8.85
Total:		28.28	82.00
BUS 15	BUS 13	.18	3.28
BUS 15	BUS 14	-1.87	-2.44
BUS 15	BUS 17	-132.80	-8.80
BUS 15	BUS 18	28.80	-3.58
BUS 15	BUS 33	-4.88	2.83
Total:		-112.80	-8.42
BUS 18	BUS 17	-108.78	-11.82
BUS 18	BUS 18	31.78	1.80
Total:		-76.00	-10.02
BUS 18	BUS 19	-31.87	-2.48
BUS 18	BUS 20	23.01	-41.17
BUS 18	BUS 15	-28.81	2.85
BUS 18	BUS 34	-20.78	-2.33
Total:		-58.28	-43.00
BUS 24	BUS 23	88.48	-2.54
BUS 24	BUS 70	-12.20	.32
BUS 24	BUS 72	-37.28	14.70
Total:		48.00	12.48
BUS 25	BUS 23	222.82	83.88
BUS 25	BUS 27	188.78	38.17
BUS 25	BUS 28	-181.27	-18.88
Total:		220.01	88.27
BUS 28	BUS 30	258.84	-1.41
BUS 28	BUS 25	181.37	24.87
Total:		420.01	23.28
BUS 27	BUS 25	-151.01	-2.58
BUS 27	BUS 28	50.07	1.85
BUS 27	BUS 32	87.88	-10.87
BUS 27	BUS 115	82.98	5.84
Total:		20.00	-5.78
BUS 31	BUS 17	-24.11	-10.78
BUS 31	BUS 28	2.00	28.33
BUS 31	BUS 32	-24.84	10.83
Total:		-46.75	28.17
BUS 32	BUS 23	-100.82	18.17
BUS 32	BUS 31	24.88	-12.18
BUS 32	BUS 27	-87.10	11.85
BUS 32	BUS 113	-4.47	-14.88
BUS 32	BUS 114	8.80	12.15
BUS 32	B 28	87.07	-20.88
Total:		-73.75	-5.85
BUS 34	BUS 19	21.13	-2.85
BUS 34	BUS 38	35.17	11.10
BUS 34	BUS 37	-142.88	-15.21
BUS 34	BUS 43	12.84	-1.18
BUS 34	BUS 34	.00	-13.58
Total:		-73.75	-21.38
BUS 38	BUS 38	-3.70	11.47
BUS 38	BUS 34	-35.05	-11.27
Total:		-38.75	.20

BUS 40	BUS 37	-18.87	-8.12
BUS 40	BUS 39	2.32	2.72
BUS 40	BUS 41	17.47	8.88
BUS 40	BUS 42	-18.81	-4.60
BUS 40	A 8	-9.01	-37.60
Total:		-25.00	-38.81

BUS 42	BUS 40	18.88	.81
BUS 42	BUS 41	28.22	8.13
BUS 42	BUS 48	-68.00	2.80
BUS 42	BUS 48	-68.00	2.80
BUS 42	A 28	28.58	-8.30
Total:		-45.25	4.88

BUS 48	BUS 45	78.31	30.25
BUS 45	BUS 47	-18.92	48.84
BUS 48	BUS 48	-8.39	18.28
BUS 48	BUS 45	.00	-11.38
Total:		84.00	85.00

BUS 48	BUS 47	37.84	5.91
BUS 48	BUS 42	81.80	.45
BUS 48	BUS 42	81.90	.45
BUS 48	BUS 45	78.22	-11.54
BUS 48	BUS 48	88.10	-40.38
BUS 48	BUS 80	84.03	10.23
BUS 48	BUS 81	82.21	14.41
BUS 48	BUS 84	35.73	8.18
BUS 48	BUS 84	35.84	8.47
BUS 48	BUS 88	-128.80	3.27
BUS 48	BUS 88	-128.80	3.27
BUS 48	BUS 89	-48.82	10.83
Total:		181.25	11.84

BUS 84	BUS 83	17.47	8.82
BUS 84	BUS 48	-34.74	-11.80
BUS 84	BUS 48	-34.41	-8.98
BUS 84	BUS 85	8.88	-1.45
BUS 84	BUS 85	-27.04	-14.84
BUS 84	BUS 89	-21.18	-3.88
Total:		-83.25	-32.81

BUS 85	BUS 84	-8.85	-.42
BUS 88	BUS 88	-47.41	-3.74
BUS 88	BUS 89	-24.83	-3.84
Total:		-78.78	-7.80

BUS 89	BUS 84	27.08	14.38
BUS 88	BUS 88	47.83	3.78
BUS 88	BUS 87	-18.41	-4.08
BUS 88	BUS 88	-2.17	.28

BUS 88	BUS 89	-17.84	-1.38
BUS 88	BUS 89	-18.88	-1.01
BUS 88	D 1	-124.80	-73.18
Total:		-185.00	-81.20

BUS 89	BUS 84	21.42	-.83
BUS 89	BUS 85	18.12	-3.28
BUS 88	BUS 88	18.88	-3.24
BUS 89	BUS 88	24.88	-.38
BUS 88	BUS 80	-42.41	8.00
BUS 88	BUS 81	-83.78	8.88
BUS 88	D 28	3.38	-4.88
BUS 89	BUS 83	-181.88	-48.83
Total:		-181.28	-48.82

BUS 81	BUS 88	84.78	-4.81
BUS 81	BUS 80	148.84	37.12
BUS 81	BUS 82	80.88	-12.88
BUS 81	BUS 84	-88.28	-8.88
Total:		180.00	13.88

BUS 82	BUS 80	.28	15.84
BUS 82	BUS 81	-80.48	12.82
BUS 82	BUS 88	-48.81	-18.84
BUS 82	BUS 87	-.43	-18.22
Total:		-88.28	-3.80

BUS 85	BUS 38	234.84	3.02
BUS 85	BUS 84	270.98	44.83
BUS 85	BUS 84	-107.78	20.28
BUS 88	BUS 88	102.28	73.88
Total:		800.01	141.80

BUS 88	BUS 48	131.78	8.81
BUS 88	BUS 48	131.78	8.81
BUS 88	BUS 82	47.83	14.38
BUS 88	BUS 87	104.48	18.82
BUS 88	D 8	137.83	21.48
BUS 88	BUS 88	-102.28	-88.48
Total:		481.28	3.01

BUS 70	BUS 88	-87.00	-12.88
BUS 70	BUS 24	12.38	-8.84
BUS 70	BUS 71	-41.88	1.34
BUS 70	BUS 74	30.80	3.08
BUS 70	BUS 78	12.81	7.24
Total:		-82.80	-10.87

BUS 72	BUS 24	38.11	-18.08
BUS 72	BUS 71	4.88	-7.22
Total:		43.00	-23.32

BUS 73	BUS 71	37.00	.95
Total:		37.00	.95
BUS 74	BUS 70	-30.50	-4.95
BUS 74	BUS 75	-54.50	17.34
BUS 74	BUS 74	.00	-11.20
Total:		-85.00	1.20
BUS 79	BUS 77	-93.43	8.87
BUS 79	BUS 118	8.43	16.37
Total:		-58.00	25.23
BUS 77	BUS 78	97.82	.48
BUS 77	BUS 89	-8.17	-27.99
BUS 77	BUS 78	85.81	2.26
BUS 77	BUS 78	39.91	33.01
BUS 77	BUS 80	-154.77	-11.83
BUS 77	BUS 80	-72.47	-11.00
BUS 77	BUS 82	-44.18	31.00
Total:		-75.25	16.95
BUS 80	BUS 77	158.81	21.63
BUS 80	BUS 77	74.02	14.16
BUS 80	BUS 78	99.41	33.15
BUS 80	BUS 86	2.71	22.74
BUS 80	BUS 87	-7.25	31.20
BUS 80	BUS 88	25.75	87.15
BUS 80	BUS 99	-35.88	18.41
BUS 80	BUS 81	120.83	-88.83
Total:		437.50	138.81
BUS 85	BUS 83	41.45	.18
BUS 85	BUS 84	39.57	3.83
BUS 85	BUS 86	22.43	-5.85
BUS 85	BUS 88	-76.48	15.70
BUS 85	BUS 89	-103.43	-14.57
BUS 85	C 5	48.47	1.91
Total:		-30.00	2.00
BUS 87	BUS 85	4.00	-19.35
Total:		4.00	-19.35
BUS 89	BUS 85	105.90	.05
BUS 88	BUS 88	140.28	32.77
BUS 89	BUS 90	85.33	21.46
BUS 88	BUS 80	122.81	48.18
BUS 89	BUS 82	187.81	22.52
BUS 88	BUS 92	89.85	2.08
BUS 89	C 2	88.32	-8.37
Total:		750.00	118.88
BUS 90	BUS 89	-83.07	-18.74
BUS 90	BUS 88	-118.85	-38.23
BUS 80	BUS 81	-28.48	7.37
BUS 80	E 5	110.80	-21.61
Total:		-87.60	-68.21
BUS 91	BUS 80	28.89	-8.78
BUS 81	BUS 92	-8.88	-34.38
Total:		20.00	-43.17
BUS 92	BUS 89	-184.72	-7.61
BUS 82	BUS 89	-58.38	-1.47
BUS 92	BUS 81	7.14	32.54
BUS 92	BUS 83	82.88	8.84
BUS 92	BUS 84	86.87	3.83
BUS 92	BUS 100	18.10	-3.25
BUS 92	BUS 102	21.21	-17.70
BUS 82	C 1	-4.48	-27.88
Total:		-81.25	-12.80
BUS 88	BUS 80	37.35	-21.88
BUS 88	BUS 100	-2.35	-2.82
Total:		35.00	-24.80
BUS 100	BUS 92	-18.87	-3.82
BUS 100	BUS 84	87.54	15.25
BUS 100	BUS 98	58.48	12.44
BUS 100	BUS 88	2.35	1.13
BUS 100	BUS 101	-5.83	2.83
BUS 100	BUS 103	100.14	5.33
BUS 100	BUS 104	53.18	10.93
BUS 100	BUS 108	58.58	17.14
Total:		303.75	51.02
BUS 102	BUS 100	-98.58	-1.88
BUS 103	BUS 104	34.94	8.43
BUS 103	BUS 105	43.11	11.07
BUS 103	BUS 110	31.78	11.98
Total:		11.25	27.60
BUS 104	BUS 100	-51.67	-10.42
BUS 104	BUS 103	-34.33	-8.33
BUS 104	BUS 105	38.70	25.44
Total:		-47.50	8.88
BUS 107	BUS 105	1.80	8.87
BUS 107	BUS 108	8.40	14.80
BUS 107	BUS 107	.00	-8.78
Total:		10.00	18.41

BUS 111	BUS 110	38.00	11.82
Total:		38.00	11.82
BUS 112	BUS 110	23.75	9.18
Total:		23.75	9.18
BUS 118	BUS 88	.00	88.91
Total:		.00	88.91
A 1	A 2	84.80	2.51
A 1	A 3	48.62	13.73
A 1	BUS 48	-34.72	18.97
Total:		100.00	35.21
A 2	A 1	-83.84	-1.81
A 2	A 4	35.04	8.54
A 2	A 5	43.81	10.03
A 2	A 8	43.18	8.86
A 2	BUS 45	14.41	35.31
Total:		52.88	82.22
A 5	A 2	-43.00	-8.27
A 5	A 7	8.44	5.58
A 5	BUS 44	-31.18	10.55
Total:		-87.75	7.88
A 8	A 8	-22.21	2.00
A 8	A 28	-4.48	3.14
A 8	BUS 40	8.20	37.88
Total:		-17.50	43.00
A 11	A 8	20.00	16.03
Total:		20.00	16.03
A 13	A 12	20.00	16.16
Total:		20.00	16.16
B 1	B 2	40.38	3.85
B 1	B 3	25.18	18.92
B 1	BUS 20	34.43	78.16
Total:		100.00	88.75
B 2	B 1	-40.10	-5.87
B 2	B 4	18.42	17.83
B 2	B 5	52.43	10.75
B 2	B 8	21.13	19.31
Total:		52.88	42.22
B	B 2	-51.17	-7.63
B	B 7	-16.58	15.48
Total:		-87.75	7.88
B	B 5	22.80	-5.45
B	B 25	-3.63	8.46
B	BUS 22	-36.67	32.87
Total:		-17.50	33.00
B 11	B 8	20.00	16.24
Total:		20.00	16.24
B 13	B 12	20.00	17.03
Total:		20.00	17.03
C 1	C 2	42.13	-5.57
C 1	C 3	53.28	12.31
C 1	BUS 82	4.58	27.25
Total:		100.00	33.88
C 2	C 1	-41.61	3.71
C 2	C 4	53.51	8.87
C 2	C 5	44.22	8.37
C 2	C 8	83.33	5.18
C 2	BUS 86	-85.38	14.32
Total:		52.87	42.22
C 5	C 2	-43.33	-8.86
C 5	C 7	21.74	3.81
C 5	BUS 85	-46.18	-1.47
Total:		-87.75	-4.52
C 8	C 8	-27.52	20.08
C 8	C 28	4.84	3.37
C 8	BUS 83	5.08	8.55
Total:		-17.50	33.00
C 11	C 8	20.00	13.71
Total:		20.00	13.71
C 13	C 12	20.00	14.48

	Total:	20.00	14.48
D 1	D 2	-35.80	8.72
D 1	D 3	8.77	8.12
D 1	BUS 56	127.03	81.16
	Total:	100.00	100.00
D 2	D 1	36.08	-11.88
D 2	D 4	22.87	8.05
D 2	D 5	-22.87	10.13
D 2	D 8	18.82	5.23
	Total:	82.87	8.73
D 5	D 2	23.15	-11.04
D 5	D 7	43.13	-.80
D 5	BUS 86	-134.04	-10.07
	Total:	-67.76	-21.71
D 8	D 5	38.54	14.80
D 8	D 28	10.43	4.25
D 8	BUS 87	-66.47	14.15
	Total:	-17.50	33.00
D 11	D 9	20.00	14.41
	Total:	20.00	14.41
D 13	D 12	20.00	15.72
	Total:	20.00	15.72
E 1	E 2	173.30	18.81
E 1	E 5	57.62	21.92
E 1	BUS 102	43.68	34.67
	Total:	276.00	73.20
E 2	E 1	-188.01	-2.55
E 2	E 3	80.59	9.84
E 2	E 4	44.27	13.76
E 2	E 5	16.83	15.15
E 2	BUS 87	39.18	-4.02
	Total:	12.86	32.22
E 3	E 2	-77.58	-1.46
E 3	E 4	-40.17	16.85
	Total:	-117.75	15.40
E 6	E 11	11.33	8.70
E 8	E 12	10.19	4.03
E 8	E 13	23.47	12.20
E 8	E 6	-58.88	-1.44
	Total:	-14.00	23.50
E 8	E 7	.00	23.86
	Total:	.00	23.86
BUS 2	BUS 1	15.80	4.00
BUS 2	BUS 12	-40.80	-16.88
	Total:	-25.00	-12.88
BUS 3	BUS 1	48.37	-3.09
BUS 3	BUS 5	-88.34	-12.88
BUS 3	BUS 12	-12.54	-12.01
	Total:	-82.50	-27.98
BUS 5	BUS 4	85.85	-9.85
BUS 5	BUS 3	100.83	21.77
BUS 5	BUS 6	137.40	3.28
BUS 5	BUS 11	105.88	8.79
BUS 5	BUS 8	-483.15	-68.08
BUS 5	BUS 9	.00	39.90
	Total:	-50.00	-26.18
BUS 7	BUS 6	-89.91	-13.08
BUS 7	BUS 12	6.18	-6.48
	Total:	-83.75	-19.55
BUS 8	BUS 8	582.28	20.04
BUS 8	BUS 10	-582.28	-30.03
	Total:	.00	.00
BUS 11	BUS 4	-86.18	-2.11
BUS 11	BUS 5	-105.58	-.28
BUS 11	BUS 12	72.38	-43.01
BUS 11	BUS 13	42.88	13.28
	Total:	-87.50	-32.18
BUS 13	BUS 11	-42.37	-13.42
BUS 13	BUS 15	-.12	-8.88
	Total:	-42.50	-22.40
BUS 14	BUS 12	-19.37	-4.71
BUS 14	BUS 15	1.87	-2.28
	Total:	-17.50	-6.99

US 16	BUS 12	-5.74	-7.03
US 16	BUS 17	-25.51	-8.88
Total:		-31.25	-15.88
US 17	BUS 15	135.28	18.81
US 17	BUS 16	25.83	3.74
US 17	BUS 18	108.28	18.82
US 17	BUS 31	24.45	8.06
US 17	BUS 113	12.10	.76
US 17	BUS 30	-318.71	-50.06
US 17	BUS 17	.00	.00
Total:		-13.75	-4.20
US 20	BUS 18	-22.44	40.86
US 20	BUS 21	33.54	22.86
US 20	G 1	-33.60	-73.67
Total:		-22.50	-5.80
US 21	BUS 20	-33.24	-23.72
US 21	BUS 22	-30.57	18.47
US 21	G 4	8.81	-15.75
Total:		-55.00	-21.00
US 22	BUS 21	30.85	-19.50
US 22	BUS 23	-124.37	34.67
US 22	G 8	37.26	-33.37
Total:		-56.25	-18.20
US 23	BUS 22	130.44	-10.18
US 23	BUS 24	-87.14	5.98
US 23	BUS 25	-218.02	-25.99
US 23	BUS 32	104.22	-6.31
Total:		-77.50	-36.20
US 28	BUS 27	-49.55	-1.26
US 28	BUS 29	28.31	-6.54
Total:		-21.25	-8.80
US 29	BUS 28	-28.08	7.24
US 29	BUS 31	-1.92	-26.84
Total:		-30.00	-19.60
US 30	BUS 6	-111.09	-80.00
US 30	BUS 28	-263.29	-31.43
US 30	BUS 38	44.58	20.22
US 30	BUS 17	319.71	91.21
Total:		.00	.00
US 33	BUS 15	4.81	-5.88
US 33	BUS 37	-33.66	-6.74
Total:		-28.75	-12.60
US 35	BUS 36	3.70	-11.71
US 35	BUS 37	-44.95	-14.88
Total:		-41.25	-26.60
US 37	BUS 35	45.21	14.77
US 37	BUS 33	34.17	5.00
US 37	BUS 34	143.43	15.85
US 37	BUS 38	31.81	9.88
US 37	BUS 40	18.21	2.76
US 37	BUS 36	-273.84	-73.82
US 37	BUS 37	.00	24.47
Total:		.00	.00
US 38	BUS 30	-44.49	-57.73
US 38	BUS 85	-228.38	-45.91
US 38	BUS 37	273.84	104.85
Total:		-.01	.00
US 39	BUS 37	-31.43	-11.23
US 39	BUS 40	-2.32	-4.17
Total:		-33.75	-15.40
US 41	BUS 40	-17.41	-6.85
US 41	BUS 42	-29.84	-7.15
Total:		-48.25	-14.00
US 43	BUS 44	-9.73	-7.20
US 43	BUS 34	-12.77	-2.60
Total:		-22.50	-9.80
US 44	BUS 43	9.81	1.89
US 44	BUS 45	-81.21	8.69
US 44	A 5	31.40	-12.69
US 44	BUS 44	.00	-8.89
Total:		-20.00	-11.20
US 45	BUS 44	62.08	-8.40
US 45	BUS 46	-75.74	-25.07
US 45	BUS 49	-75.08	18.25
US 45	A 2	-14.01	-37.75
US 45	BUS 45	.00	-10.00
Total:		-103.75	-83.00

BUS 47	BUS 46	18.80	-48.00
BUS 47	BUS 48	-37.87	-6.88
BUS 47	BUS 88	-82.23	12.68
Total:		-80.00	-42.00
BUS 48	BUS 46	8.85	-22.70
BUS 48	BUS 48	-67.04	42.03
BUS 48	A 1	35.39	-18.71
BUS 48	BUS 48	.00	-18.02
Total:		-25.00	-16.40
BUS 50	BUS 48	-53.26	-9.88
BUS 50	BUS 57	32.01	4.38
Total:		-21.25	-5.50
BUS 51	BUS 48	-50.30	-13.45
BUS 51	BUS 82	34.22	6.34
BUS 51	BUS 88	17.25	.20
BUS 51	D 4	-12.43	-7.26
Total:		-21.25	-11.20
BUS 52	BUS 51	-33.95	-8.89
BUS 52	BUS 83	11.45	1.88
Total:		-22.50	-7.00
BUS 53	BUS 52	-11.39	-5.36
BUS 53	BUS 54	-17.36	-10.04
Total:		-28.75	-16.40
BUS 57	BUS 56	16.61	3.03
BUS 57	BUS 60	-31.61	-8.23
Total:		-15.00	-4.20
BUS 58	BUS 56	2.17	-2.53
BUS 58	BUS 61	-17.17	-1.67
Total:		-15.00	-4.20
BUS 60	BUS 58	43.02	-6.82
BUS 60	BUS 61	-140.27	-34.55
BUS 60	BUS 62	-.25	-15.83
Total:		-97.50	-60.20
BUS 83	BUS 56	-181.85	-83.88
BUS 83	BUS 88	181.85	83.88
Total:		.00	.00
BUS 54	BUS 83	182.61	51.18
BUS 84	BUS 85	-268.88	-58.87
BUS 84	BUS 81	86.26	7.68
Total:		.00	.00
BUS 87	BUS 82	-.38	13.35
BUS 87	BUS 88	-102.15	-11.25
BUS 87	D 8	37.62	-11.80
Total:		-35.00	-9.80
US 88	BUS 85	107.92	-44.82
US 88	BUS 81	-120.32	38.11
US 88	BUS 118	.03	-88.20
US 88	BUS 89	12.37	103.80
Total:		.00	.00
US 71	BUS 70	41.74	-1.68
US 71	BUS 72	-4.88	3.03
US 71	BUS 73	-36.88	-1.47
Total:		.00	.00
JS 75	BUS 70	-12.70	-10.31
JS 75	BUS 89	-112.06	-12.33
JS 75	BUS 74	84.94	-18.88
JS 75	BUS 77	-63.23	1.47
JS 75	BUS 118	33.05	3.04
Total:		-100.00	-36.00
S 78	BUS 77	-38.81	-33.07
S 78	BUS 78	-48.84	-3.33
Total:		-88.75	-36.40
S 78	BUS 78	48.07	3.29
S 78	BUS 80	-87.82	-27.81
S 78	BUS 78	.00	-20.18
Total:		-48.75	-44.80
S 81	BUS 88	120.83	-85.82
S 81	BUS 80	-120.83	85.82
Total:		.00	.00
S 82	BUS 77	45.08	-31.37
S 82	BUS 83	-46.85	-3.47
S 82	BUS 88	-46.05	10.38
S 82	C 28	-20.88	6.48
S 82	BUS 82	.00	-19.71
Total:		-87.80	-37.80

BUS 83	BUS 82	45.88	3.10
BUS 83	BUS 84	-25.08	4.15
BUS 83	BUS 85	-40.73	-1.28
BUS 83	C 8	-5.07	-10.01
BUS 83	BUS 53	.00	-9.98
Total:		-25.00	-14.00
BUS 84	BUS 83	25.43	-5.88
BUS 84	BUS 85	-39.18	-3.91
Total:		-13.75	-9.80
BUS 88	BUS 85	-22.28	3.52
BUS 88	BUS 87	-4.00	-17.52
Total:		-26.25	-14.00
BUS 88	BUS 85	77.88	-13.47
BUS 88	BUS 89	-137.88	-21.53
Total:		-60.00	-35.00
BUS 83	BUS 82	-81.91	-7.95
BUS 83	BUS 84	65.91	-1.84
Total:		-15.00	-8.80
BUS 84	BUS 82	-84.54	-3.38
BUS 84	BUS 83	-48.42	1.84
BUS 84	BUS 85	88.24	8.22
BUS 84	BUS 86	52.14	-11.88
BUS 84	BUS 100	-55.92	-15.10
Total:		-37.50	-22.40
BUS 85	BUS 84	-87.81	-5.27
BUS 85	BUS 88	27.88	-23.48
BUS 85	C 4	-12.57	-14.84
Total:		-52.50	-43.40
BUS 86	BUS 80	-2.48	-28.78
BUS 86	BUS 82	46.42	-10.73
BUS 86	BUS 84	-51.38	12.07
BUS 86	BUS 85	-27.45	22.76
BUS 86	BUS 87	-12.58	-16.35
Total:		-47.50	-21.00
BUS 87	BUS 80	7.44	-32.81
BUS 87	BUS 88	12.87	16.33
BUS 87	E 2	-36.66	3.96
Total:		-16.75	-12.60
BUS 88	BUS 80	-24.85	-55.95
BUS 88	BUS 100	-55.18	-11.25
Total:		-80.00	-67.20
BUS 101	BUS 100	5.84	-5.96
BUS 101	BUS 102	-33.14	-15.05
Total:		-27.50	-21.00
BUS 102	BUS 92	-21.12	16.52
BUS 102	BUS 101	33.46	13.36
BUS 102	E 1	-43.58	-34.08
Total:		-31.25	-4.20
BUS 105	BUS 103	-42.02	-11.87
BUS 105	BUS 104	-38.47	-25.48
BUS 105	BUS 106	21.83	18.88
BUS 105	BUS 107	-1.52	-13.73
BUS 105	BUS 108	21.44	4.82
BUS 105	BUS 109	.00	-16.32
Total:		-38.75	-47.80
BUS 105	BUS 100	-55.33	-14.58
BUS 105	BUS 106	-21.71	-17.52
BUS 109	BUS 107	-8.21	-18.28
Total:		-85.25	-50.40
BUS 106	BUS 105	-21.30	-8.22
BUS 106	BUS 109	18.80	6.82
Total:		-2.50	-1.40
BUS 109	BUS 106	-18.75	-5.37
BUS 109	BUS 110	-41.25	-8.83
Total:		-60.00	-14.00
BUS 110	BUS 103	-31.31	-14.31
BUS 110	BUS 109	41.80	8.30
BUS 110	BUS 111	-35.87	-12.86
BUS 110	BUS 112	-23.56	-10.92
BUS 110	BUS 110	.00	-5.56
Total:		-48.75	-35.14
113	BUS 17	-12.09	-1.47
113	BUS 32	4.59	10.43
Total:		-7.50	8.95
114	BUS 32	-5.47	-13.61
114	BUS 115	-18.53	9.31
Total:		-25.00	-4.20

BUS 116	BUS 27		-62.28	-4.49
BUS 116	BUS 114		18.54	-9.51
	Total:		-43.75	-14.00
BUS 117	BUS 12		-25.00	-11.19
	Total:		-25.00	-11.19
BUS 118	BUS 75		-32.88	-3.58
BUS 118	BUS 76		-8.37	-17.42
	Total:		-41.25	-21.00
3	A	1	-48.71	-11.34
3	A	4	45.71	8.86
	Total:		-3.00	-1.58
4	A	2	-34.31	-12.19
4	A	3	-48.43	-10.13
4	A	6	38.81	2.08
4	A	12	34.33	17.88
	Total:		-8.60	-2.24
5	A	2	-42.07	-11.57
5	A	4	-36.75	-2.00
5	A	7	22.25	3.20
5	A	8	22.27	-2.23
5	A	28	-.12	11.81
5	A	9	18.74	-2.55
5	A	10	14.67	3.34
	Total:		.00	.00
7	A	5	-6.38	-9.89
7	A	8	-22.11	-6.37
	Total:		-28.50	-16.26
9	A	11	-20.00	-14.78
9	A	10	38.74	11.52
9	A	8	-18.74	3.26
	Total:		.00	.00
10	A	5	-38.74	-8.78
10	A	20	11.28	4.40
10	A	17	7.14	8.41
10	A	21	18.82	12.89
10	A	22	8.83	8.72
10	A	9	-14.67	-2.14
10	A	10	.00	-18.30
	Total:		-7.25	-2.80
12	A	13	-20.00	-15.34
12	A	14	8.74	4.08
12	A	15	21.86	8.67
12	A	19	8.83	8.83
12	A	4	-34.33	-16.82
	Total:		-14.00	-10.60
14	A	12	-8.81	-3.78
14	A	15	1.88	1.55
	Total:		-7.75	-2.24
15	A	12	-21.60	-8.15
15	A	14	-1.86	-1.64
15	A	18	7.59	3.13
15	A	23	5.81	4.07
	Total:		-10.25	-3.60
16	A	12	-8.53	-5.33
16	A	17	4.18	3.81
	Total:		-4.36	-2.52
17	A	15	-4.14	-2.78
17	A	10	-7.11	-5.28
	Total:		-11.25	-8.12
18	A	15	-7.52	-2.98
18	A	18	3.52	1.72
	Total:		-4.00	-1.26
19	A	18	-3.51	-1.70
19	A	20	-8.38	-3.08
	Total:		-11.87	-4.78
20	A	18	8.38	3.12
20	A	10	-11.14	-4.10
	Total:		-2.75	-.98
21	A	10	-19.64	-12.61
21	A	22	-3.23	-3.17
	Total:		-21.87	-15.88
22	A	10	-8.85	-8.85
22	A	21	3.23	3.18
22	A	24	5.61	5.37
	Total:		.00	.00

A 23		A 15	-5.57	-3.87
A 23		A 24	1.57	1.73
	Total:		-4.00	-2.24
A 24		A 22	-5.57	-2.31
A 24		A 23	-1.56	-1.71
A 24		A 25	-3.75	-1.50
A 24		A 24	.00	-3.56
	Total:		-10.87	-8.38
A 25		A 24	3.75	1.55
A 25		A 26	4.44	3.34
A 25		A 27	-8.22	-4.90
	Total:		.00	.00
A 26		A 25	-4.37	-3.22
	Total:		-4.37	-3.22
A 27		A 25	5.32	5.09
A 27		A 26	5.46	2.34
A 27		A 30	9.96	3.04
A 27		A 28	-20.75	-10.47
	Total:		.00	.00
A 28		A 8	.14	-12.35
A 28		A 8	4.51	-5.14
A 28		BUS 42	-25.40	4.85
A 28		A 27	20.75	12.55
	Total:		.00	.00
A 29		A 27	-5.39	-2.23
A 29		A 30	2.39	.97
	Total:		-3.00	-1.25
A 30		A 27	-6.57	-2.54
A 30		A 29	-2.38	-.84
	Total:		-8.25	-3.75
3		B 1	-24.75	-16.34
3		B 4	21.75	17.65
	Total:		-3.00	-1.68
4		B 2	-16.85	-22.42
4		B 3	-21.55	-15.84
4		B 8	5.03	7.84
4		BUS 21	-5.73	13.47
4		B 12	21.84	17.70
	Total:		-8.50	-2.24
5		B 2	-20.62	-23.74
5		B 4	-5.01	-5.03
5		B 7	45.93	-4.71
5		B 8	-22.73	5.25
5		B 25	-25.75	25.25
5		B 6	10.24	-2.45
5		B 10	14.95	3.42
	Total:		.00	.00
7		B 5	10.85	-10.14
7		B 9	-45.35	3.85
	Total:		-25.50	-10.25
9		B 11	-20.00	-14.85
9		B 10	30.24	11.74
9		B 6	-10.24	3.24
	Total:		.00	.00
10		B 5	-35.24	-5.87
10		B 20	11.75	4.25
10		B 17	5.13	5.07
10		B 21	15.41	13.25
10		B 22	5.85	5.85
10		B 6	-14.85	-2.17
10		B 10	.00	-10.27
	Total:		-7.25	-2.50
12		B 13	-20.00	-15.15
12		B 14	5.41	4.19
12		B 15	20.81	10.35
12		B 16	7.83	5.84
12		B 4	-31.84	-14.72
	Total:		-14.00	-10.50
14		B 12	-5.25	-3.83
4		B 15	1.53	1.59
	Total:		-7.75	-2.24
5		B 12	-20.47	-5.85
5		B 14	-1.53	-1.85
5		B 15	7.13	3.27
5		B 23	4.62	4.53
	Total:		-10.25	-3.50
5		B 12	-7.54	-5.87
5		B 17	3.17	3.15
	Total:		-4.37	-2.52

B 17		B 16	-3.15	-3.11
B 17		B 10	-8.10	-5.01
	Total:		-11.25	-8.12
B 18		B 15	-7.08	-3.14
B 18		B 19	-3.08	-1.88
	Total:		-4.00	-1.28
B 19		B 18	-3.08	-1.88
B 19		B 20	-8.82	-2.90
	Total:		-11.87	-4.78
B 20		B 19	8.85	2.88
B 20		B 10	-11.60	-3.84
	Total:		-2.75	-.86
B 21		B 10	-15.24	-12.81
B 21		B 22	-3.84	-2.77
	Total:		-21.87	-15.88
B 22		B 10	-5.58	-5.82
B 22		B 21	3.84	2.78
B 22		B 24	4.84	3.04
	Total:		.00	.00
B 23		B 15	-4.58	-4.50
B 23		B 24	-.58	2.28
	Total:		-4.00	-2.24
B 24		B 22	-4.80	-2.88
B 24		B 23	-.57	-2.25
B 24		B 25	-5.40	-.30
B 24		B 24	.00	-3.85
	Total:		-10.87	-9.38
B 25		B 24	5.48	.40
B 25		B 26	4.44	3.34
B 25		B 27	-8.80	-3.74
	Total:		.00	.00
B 26		B 25	-4.37	-3.22
	Total:		-4.37	-3.22
27		B 25	10.03	3.88
27		B 26	5.45	2.34
27		B 30	5.88	3.04
27		B 28	-22.48	-9.38
	Total:		.00	.00
28		B 8	28.08	-28.87
28		B 6	3.37	-8.41
28		BUS_32	-55.18	25.83
28		B 27	22.48	11.85
	Total:		.00	.00
28		B 27	-5.39	-2.23
28		B 30	2.38	.97
	Total:		-3.00	-1.26
30		B 27	-6.87	-2.84
30		B 28	-2.38	-.94
	Total:		-9.25	-3.78
3		C 1	-52.04	-8.40
3		C 4	49.04	7.72
	Total:		-3.00	-1.58
4		C 2	-51.83	-10.80
4		C 3	-46.72	-6.08
4		C 8	43.08	-13.30
4		BUS_85	12.84	13.84
4		C 12	36.43	18.01
	Total:		-8.50	-2.24
5		C 2	-81.15	-5.80
5		C 4	-42.83	15.71
5		C 7	7.01	4.88
5		C 8	27.85	-20.05
5		C 28	35.30	1.80
5		C 9	18.09	-.82
5		C 10	14.81	4.08
	Total:		.00	.00
7		C 5	-21.81	-7.70
7		C 8	-6.89	-7.58
	Total:		-28.50	-15.28
8		C 11	-20.00	-12.50
8		C 10	38.09	11.26
8		C 6	-18.08	1.35
	Total:		.00	.00

C 10	C 9	-38.08	-8.62
C 10	C 20	11.18	4.76
C 10	C 17	8.80	5.14
C 10	C 21	18.44	12.80
C 10	C 22	8.33	5.62
C 10	C 8	-14.91	-2.81
C 10	C 10	.00	-19.48
Total:		-7.28	-2.80

C 12	C 13	-20.00	-13.70
C 12	C 14	8.81	3.83
C 12	C 15	22.65	8.08
C 12	C 16	8.98	4.79
C 12	C 4	-36.43	-14.48
Total:		-14.00	-10.80

C 14	C 12	-8.78	-3.86
C 14	C 15	2.03	1.32
Total:		-7.75	-2.24

C 15	C 12	-22.16	-8.34
C 15	C 14	-2.03	-1.31
C 15	C 19	7.88	2.74
C 15	C 23	6.26	3.36
Total:		-10.25	-3.80

C 16	C 12	-8.87	-4.80
C 16	C 17	4.48	2.08
Total:		-4.37	-2.82

C 17	C 16	-4.47	-2.04
C 17	C 10	-8.78	-6.08
Total:		-11.25	-8.12

C 18	C 15	-7.81	-2.82
C 18	C 16	3.81	1.38
Total:		-4.00	-1.28

C 18	C 18	-3.80	-1.34
C 18	C 20	-8.27	-2.42
Total:		-11.87	-4.76

C 20	C 19	8.30	3.47
C 20	C 10	-11.08	-4.48
Total:		-2.75	-.88

C 21	C 10	-18.26	-12.21

C 21	C 22	-2.62	-3.47
Total:		-21.87	-15.88

22	C 10	-8.24	-5.38
22	C 21	2.62	3.48
22	C 24	5.62	1.87
Total:		.00	.00

23	C 15	-8.23	-3.28
23	C 24	2.23	1.04
Total:		-4.00	-2.24

24	C 22	-8.87	-1.79
24	C 23	-2.22	-1.02
24	C 25	-2.08	-2.88
24	C 24	.00	-3.89
Total:		-10.87	-8.38

25	C 24	2.11	2.72
25	C 26	4.44	3.34
25	C 27	-8.85	-8.06
Total:		.00	.00

26	C 25	-4.37	-3.22
Total:		-4.37	-3.22

27	C 25	8.83	5.22
27	C 26	5.46	2.33
27	C 30	8.58	3.04
27	C 26	-18.06	-11.59
Total:		.00	.00

28	C 8	-35.08	-1.40
28	C 8	-4.81	-6.41
28	BUS 82	20.84	-5.88
28	C 27	18.06	13.49
Total:		.00	.00

29	C 27	-5.38	-2.23
29	C 30	2.38	.97
Total:		-3.00	-1.26

30	C 27	-8.87	-2.84
30	C 28	-2.38	-.94
Total:		-9.26	-3.78

D 3	D 1	-6.59	-10.86
D 3	D 4	5.59	9.20
Total:		-3.00	-1.66
D 4	D 2	-22.64	-10.81
D 4	D 3	-5.67	-10.42
D 4	D 6	-23.85	-2.64
D 4	BUS 51	12.52	5.46
D 4	D 12	30.14	16.37
Total:		-9.50	-2.24
D 6	D 2	-15.82	-10.53
D 6	D 4	24.02	2.64
D 6	D 7	-13.68	11.47
D 6	D 8	-35.34	-14.35
D 8	D 25	7.50	8.11
D 8	D 8	21.03	-1.20
D 8	D 10	19.00	3.85
Total:		.00	.00
D 7	D 5	-42.28	-1.44
D 7	D 8	13.78	-13.82
Total:		-28.50	-15.26
D 8	D 11	-20.00	-13.28
D 8	D 10	41.03	11.18
D 8	D 8	-21.03	3.09
Total:		.00	.00
D 10	D 8	-41.03	-8.27
D 10	D 20	12.35	4.45
D 10	D 17	8.09	5.48
D 10	D 21	18.18	12.78
D 10	D 22	8.15	5.84
D 10	D 8	-16.00	-2.44
D 10	D 10	.00	-19.44
Total:		-7.25	-2.80
D 12	D 13	-20.00	-15.85
D 12	D 14	8.24	3.88
D 12	D 15	20.25	8.88
D 12	D 15	8.64	5.38
D 12	D 4	-30.14	-13.72
Total:		-14.00	-10.60
D 14	D 12	-8.13	-3.75
D 14	D 15	1.38	1.51
Total:		-7.75	-2.24
D 15	D 12	-15.83	-8.07
D 15	D 14	-1.37	-1.50
D 15	D 18	8.62	3.10
D 15	D 23	4.63	3.97
Total:		-10.25	-3.50
15	D 12	-5.56	-5.25
15	D 17	2.20	2.73
Total:		-4.37	-2.52
17	D 15	-2.15	-2.71
17	D 10	-9.08	-5.41
Total:		-11.25	-8.12
18	D 15	-6.47	-2.88
18	D 19	2.47	1.73
Total:		-4.00	-1.25
19	D 18	-2.46	-1.72
19	D 20	-9.41	-3.04
Total:		-11.88	-4.75
20	D 18	8.45	3.11
20	D 10	-12.20	-4.08
Total:		-2.75	-.88
21	D 10	-15.88	-12.38
21	D 22	-3.88	-3.25
Total:		-21.88	-15.88
22	D 10	-8.07	-5.47
22	D 21	2.68	3.30
22	D 24	5.19	2.17
Total:		.00	.00
23	D 15	-4.48	-3.80
23	D 24	.48	1.56
Total:		-4.00	-2.24
24	D 22	-5.14	-2.10
24	D 23	-.48	-1.55
24	D 25	-4.24	-1.75
24	D 24	.00	-2.88
Total:		-10.87	-8.38
25	D 24	4.26	1.53

D 25	D 27	-8.72	-5.16
Total:		.00	.00
D 26	D 25	-4.38	-3.22
Total:		-4.38	-3.22
D 27	D 25	8.84	5.38
D 27	D 29	5.46	2.33
D 27	D 30	6.88	3.04
D 27	D 26	-21.26	-10.75
Total:		.00	.00
D 28	D 6	-7.58	-6.87
D 28	D 8	-10.35	-6.11
D 28	BUS 55	-3.33	1.87
D 28	D 27	21.26	12.91
Total:		.00	.00
D 29	D 27	-5.38	-2.23
D 29	D 30	-2.38	-.84
Total:		-3.70	-1.49
D 30	D 27	-8.87	-2.84
D 30	D 29	-2.38	-.84
Total:		-9.25	-3.78
E 4	E 2	-43.04	-13.89
E 4	E 3	41.87	-16.84
E 4	E 5	-110.07	8.75
E 4	E 7	32.88	-8.96
E 4	E 8	18.78	1.13
Total:		-58.75	-28.00
E 5	E 1	-55.90	-18.10
E 5	E 2	-16.52	-17.92
E 5	E 4	111.61	-6.47
E 5	BUS 50	-107.88	30.35
E 5	E 8	56.88	9.59
Total:		-9.80	-2.24
E 7	E 6	.00	-23.09
E 7	E 9	32.88	11.81
E 7	E 4	-32.89	11.15
Total:		.00	.00
E 8	E 7	-32.88	-10.56
E 8	E 10	4.55	2.49
E 8	E 14	10.35	2.92
E 9	E 4	-18.78	.65
E 9	E 8	.00	-18.80
Total:		-38.87	-23.24
E 10	E 9	-4.54	-2.46
E 10	E 11	-8.71	-5.66
Total:		-11.26	-8.12
E 11	E 6	-11.15	-8.32
E 11	E 10	8.77	5.81
Total:		-4.38	-2.52
E 12	E 8	-10.05	-3.75
E 12	E 13	2.43	1.51
Total:		-7.63	-2.24
E 13	E 8	-23.04	-11.38
E 13	E 12	-2.41	-1.48
E 13	E 14	5.58	4.73
Total:		-18.88	-8.12
E 14	E 9	-10.21	-2.60
E 14	E 13	-8.42	-4.40
Total:		-18.62	-7.00

System losses:	245.40	-35.48
(I**2,R*I**2):	245.40	1404.55

Appendix I

250 Bus Network

Base Case C

I.1. Bus Oriented Results

I.2. Line Flow Results

```
    Time for input:  3.26
    Time for compact:   .27
    Time for factorization:   .32
No. of iterations: 38
Maximum mismatch (in pu):  8.0E-05 9.0E-04
    Time for solution:  1.08
Execution time:  4.93

S base : 100.
```

Bus	Vsp	Voltage		Generation		QGmin	QGmax	Load	
BUS 69		1.035	30.00	115.11	-29.93				
BUS 1	.960	.948-	5.15	.00	35.00	-5.00	35.00	66.30	37.80
BUS 4	.998	.998	12.54	50.00	38.65	-300.00	300.00	39.00	16.80
BUS 6	.990	.982-	8.53	.00	50.00	-13.00	50.00	67.60	30.80
BUS 8	1.015	1.015	20.42	40.00	228.17	-300.00	300.00	.00	14.00
BUS 10	1.055	1.055	39.43	570.00	60.69	-147.00	200.00	.00	.00
BUS 12	.990	.977-	7.54	85.00	120.00	-35.00	120.00	61.10	28.00
BUS 15	.970	.969-	7.08	.00	50.00	-10.00	50.00	117.00	56.00
BUS 18	.973	.973	7.25	.00	41.64	-16.00	50.00	78.00	47.60
BUS 19	.960	.966+	6.38	.00	-7.99	-8.00	24.00	58.50	35.00
BUS 24	.992	.992	19.76	49.00	14.98	-300.00	300.00	.00	.00
BUS 25	1.050	1.050	26.57	220.00	88.44	-47.00	140.00	.00	.00
BUS 26	1.015	1.015	29.97	420.00	22.42	-1000.00	1000.00	.00	.00
BUS 27	.968	.968	12.23	45.00	14.08	-300.00	300.00	26.00	18.20
BUS 31	.967	.967	7.79	7.00	65.27	-300.00	300.00	55.90	37.80
BUS 32	.963	.963	9.36	.00	31.49	-14.00	42.00	76.70	32.20
BUS 34	.984	.983-	11.93	.00	24.00	-8.00	24.00	76.70	36.40
BUS 36	.980	.977-	11.43	.00	24.00	-8.00	24.00	40.30	23.80
BUS 40	.970	.970	14.91	80.00	-28.60	-300.00	300.00	26.00	32.20
BUS 42	.985	.985	17.50	90.00	9.08	-300.00	300.00	48.10	32.20
BUS 46	1.080	1.067-	20.52	89.00	100.00	-100.00	100.00	36.40	14.00
BUS 49	1.025	1.025	23.90	300.00	40.91	-85.00	210.00	113.10	42.00
BUS 54	.970	.970	17.58	48.00	46.35	-300.00	300.00	146.90	72.80
BUS 55	.970	.969-	17.26	.00	23.00	-8.00	23.00	81.90	30.80
BUS 56	.970	.972+	17.71	.00	-8.00	-8.00	15.00	109.20	53.20
BUS 59	.985	.985	20.41	155.00	114.10	-60.00	180.00	360.10	158.20
BUS 61	.995	.995	25.47	160.00	16.81	-100.00	300.00	.00	.00
BUS 62	.998	.995-	24.29	.00	30.00	-20.00	30.00	100.10	33.60
BUS 65	1.005	1.005	31.90	500.00	150.51	-67.00	200.00	.00	.00
BUS 66	1.050	1.050	29.89	500.00	27.83	-67.00	200.00	50.70	25.20
BUS 70	.984	.984	23.20	.00	20.53	-10.00	32.00	85.80	28.00
BUS 72	.980	.980	24.64	43.00	-23.28	-100.00	100.00	.00	.00
BUS 73	.991	.991	25.04	37.00	.95	-100.00	100.00	.00	.00
BUS 74	.975	.964-	20.99	.00	39.00	-6.00	39.00	88.40	37.80
BUS 76	.970	.969-	22.14	.00	80.00	-8.00	80.00	88.40	51.80
BUS 77	1.006	1.006	31.53	.00	59.22	-20.00	70.00	79.30	28.00
BUS 80	1.040	1.040	36.13	600.00	220.42	-165.00	280.00	169.00	78.40
BUS 85	1.020	1.017-	40.40	.00	23.00	-8.00	23.00	31.20	21.00
BUS 87	1.015	1.015	39.17	4.00	-18.86	-100.00	1000.00	.00	.00
BUS 89	1.055	1.055	51.05	750.00	129.06	-210.00	300.00	.00	.00
BUS 90	.985	.985	47.19	120.00	-23.51	-300.00	300.00	101.40	72.80
BUS 91	.985	.985	47.50	20.00	-42.43	-100.00	100.00	.00	.00
BUS 92	1.030	1.029-	45.64	.00	20.00	-3.00	20.00	84.50	28.00
BUS 99	1.015	1.015	41.08	35.00	-24.27	-100.00	100.00	.00	.00
BUS 100	1.017	1.017	41.29	350.00	95.51	-50.00	155.00	48.10	25.20

BUS 103	1.000	.999-	38.10	40.00	50.00	-15.00	50.00	29.90	22.40
BUS 104	.971	.971	34.90	.00	44.38	-8.00	53.00	49.40	35.00
BUS 107	.980	.980	33.77	45.00	36.39	-200.00	200.00	36.40	16.80
BUS 111	.980	.980	36.08	36.00	12.44	-100.00	1000.00	.00	.00
BUS 112	.975	.975	35.32	55.00	28.46	-100.00	1000.00	32.50	18.20
BUS 116	1.005	1.005	33.65	210.00	84.99	-1000.00	1000.00	.00	.00
A 1	1.050	1.050	19.28	100.00	33.79	-100.00	100.00	.00	.00
A 2	1.045	1.033-	16.85	80.00	80.00	-20.00	80.00	28.21	17.78
A 5	1.010	.994-	12.04	50.00	62.45	-15.00	62.45	122.46	54.60
A 8	1.000	.989-	14.28	20.00	85.00	-15.00	85.00	39.00	42.00
A 11	1.050	1.050	14.16	20.00	16.27	-10.00	45.83	.00	.00
A 13	1.050	1.050	11.57	20.00	16.65	-15.00	56.57	.00	.00
B 1	1.050	1.046-	3.51	100.00	100.00	-100.00	100.00	.00	.00
B 2	1.045	1.035-	2.18	80.00	60.00	-20.00	60.00	28.21	17.78
B 5	1.010	.991-	-3.65	50.00	62.45	-15.00	62.45	122.46	54.60
B 8	1.010	.986-	1.39	20.00	75.00	-15.00	75.00	39.00	42.00
B 11	1.050	1.050	.59	20.00	17.72	-10.00	45.83	.00	.00
B 13	1.050	1.050	-2.15	20.00	18.79	-15.00	56.57	.00	.00
C 1	1.050	1.050	45.17	100.00	39.27	-100.00	100.00	.00	.00
C 2	1.045	1.044-	43.77	80.00	60.00	-20.00	60.00	28.21	17.78
C 5	1.010	1.010	38.99	50.00	56.21	-15.00	62.45	122.46	54.60
C 8	1.010	1.002-	36.49	20.00	75.00	-15.00	75.00	39.00	42.00
C 11	1.050	1.050	37.23	20.00	14.61	-10.00	45.83	.00	.00
C 13	1.050	1.050	35.03	20.00	15.51	-15.00	56.57	.00	.00
D 1	1.025	1.019-	20.24	100.00	100.00	-100.00	100.00	.00	.00
D 2	1.020	1.020	21.48	80.00	29.50	-20.00	60.00	28.21	17.78
D 5	1.010	1.010	24.47	50.00	36.12	-15.00	62.45	122.46	54.60
D 8	1.010	1.006-	20.94	20.00	75.00	-15.00	75.00	39.00	42.00
D 11	1.050	1.050	19.72	20.00	14.89	-10.00	45.83	.00	.00
D 13	1.050	1.050	16.70	20.00	17.28	-15.00	56.57	.00	.00
E 1	1.060	1.052-	45.60	300.00	90.00	-40.00	90.00	26.00	16.80
E 2	1.045	1.013-	40.20	40.00	50.00	-40.00	50.00	28.21	17.78
E 3	.970	.961-	31.18	.00	70.00	.00	70.00	122.46	54.60
E 6	1.040	1.032-	31.84	.00	34.00	-6.00	34.00	14.56	10.50
E 8	1.050	1.050	32.70	.00	26.39	-6.00	34.00	.00	.00

Bus	Voltage		Load	
BUS 2	.958	6.11	26.00	12.60
BUS 3	.953	6.52	65.00	28.00
BUS 5	.999	12.97	52.00	25.20
BUS 7	.975	7.67	66.30	19.60
BUS 9	1.028	29.81	.00	.00
BUS 11	.973	8.57	91.00	32.20
BUS 13	.953	6.89	44.20	22.40
BUS 14	.970	6.88	18.20	7.00
BUS 16	.971	7.44	32.50	14.00
BUS 17	.994	10.42	14.30	4.20
BUS 20	1.007	3.33	23.40	9.80
BUS 21	.981	1.68	57.20	21.00
BUS 22	.968	3.69	58.50	18.20
BUS 23	.980	16.87	80.60	39.20
BUS 28	.957	9.61	22.10	9.80
BUS 29	.957	7.88	31.20	19.60
BUS 30	.980	17.80	.00	.00
BUS 33	.964	8.69	29.90	12.60
BUS 35	.976	11.48	42.90	26.60
BUS 37	.988	12.80	.00	.00
BUS 38	.956	17.86	.00	.00
BUS 39	.967	13.41	35.10	15.40
BUS 41	.964	14.63	48.10	14.00
BUS 43	.976	11.01	23.40	9.80
BUS 44	.993	12.90	20.80	11.20
BUS 45	1.000	16.03	107.90	63.00
BUS 47	1.015	22.26	83.20	42.00
BUS 48	1.034	21.92	26.00	15.40
BUS 50	1.003	21.56	22.10	5.60
BUS 51	.976	18.81	22.10	11.20
BUS 52	.963	17.62	23.40	7.00
BUS 53	.953	16.42	29.90	15.40
BUS 57	.980	18.85	15.60	4.20
BUS 58	.971	17.97	15.60	4.20
BUS 60	.986	24.38	101.40	60.20
BUS 63	.966	24.68	.00	.00
BUS 64	.981	26.93	.00	.00
BUS 67	1.012	24.09	36.40	9.80
BUS 68	1.001	33.18	.00	.00
BUS 71	.987	24.06	.00	.00
BUS 75	.964	22.61	104.00	35.00
BUS 78	1.000	31.36	92.30	36.40
BUS 79	1.004	32.16	50.70	44.80
BUS 81	.993	34.33	.00	.00
BUS 82	.990	35.22	70.20	37.80
BUS 83	.997	36.41	26.00	14.00
BUS 84	1.004	38.84	14.30	9.80
BUS 86	1.015	38.71	27.30	14.00
BUS 88	1.016	45.49	62.40	35.00
BUS 93	1.005	42.33	15.60	9.80
BUS 94	.996	39.93	39.00	22.40
BUS 95	.984	38.16	54.60	43.40
BUS 96	.992	36.90	49.40	21.00
BUS 97	1.009	37.55	19.50	12.60
BUS 98	.972	35.38	83.20	67.20
BUS 101	1.012	42.32	28.60	21.00

BUS 102	1.034	44.74	32.50	4.20
BUS 105	.956	34.08	40.30	47.60
BUS 106	.943	33.46	89.70	50.40
BUS 108	.946	33.11	2.60	1.40
BUS 109	.942	32.76	62.40	14.00
BUS 110	.962	34.61	50.70	35.14
BUS 113	.992	10.11	7.80	-8.96
BUS 114	.954	9.18	26.00	4.20
BUS 115	.953	9.32	45.50	14.00
BUS 117	.953	5.49	26.00	11.20
BUS 118	.957	21.81	42.90	21.00
A 3	1.006	15.44	3.12	1.68
A 4	.996	14.71	9.88	2.24
A 6	.990	14.29	.00	.00
A 7	.980	12.67	29.64	15.26
A 9	1.019	11.93	.00	.00
A 10	1.007	9.45	7.54	2.80
A 12	1.028	10.08	14.56	10.50
A 14	1.006	8.96	8.06	2.24
A 15	1.001	8.86	10.66	3.50
A 16	1.009	9.48	4.55	2.52
A 17	1.001	9.23	11.70	8.12
A 18	.986	8.10	4.16	1.26
A 19	.982	7.92	12.35	4.76
A 20	.987	8.22	2.86	.98
A 21	.990	8.88	22.75	15.68
A 22	.992	8.91	.00	.00
A 23	.987	8.52	4.16	2.24
A 24	.981	8.54	11.31	9.38
A 25	.994	9.46	.00	.00
A 26	.972	8.83	4.55	3.22
A 27	1.014	10.37	.00	.00
A 28	.983	15.25	.00	.00
A 29	.997	9.57	3.12	1.26
A 30	.989	9.21	9.62	3.78
B 3	1.000	1.30	3.12	1.68
B 4	.990	.93	9.88	2.24
B 6	.986	.76	.00	.00
B 7	.976	-1.68	29.64	15.26
B 9	1.016	-1.65	.00	.00
B 10	1.003	-4.16	7.54	2.80
B 12	1.025	-3.64	14.56	10.50
B 14	1.003	-4.74	8.06	2.24
B 15	.998	-4.83	10.66	3.50
B 16	1.006	-4.19	4.55	2.52
B 17	.997	-4.40	11.70	8.12
B 18	.983	-5.56	4.16	1.26
B 19	.978	-5.73	12.35	4.76
B 20	.983	-5.42	2.86	.98
B 21	.987	-4.72	22.75	15.68
B 22	.988	-4.69	.00	.00
B 23	.984	-5.11	4.16	2.24
B 24	.976	-5.01	11.31	9.38
B 25	.988	-3.91	.00	.00
B 26	.965	-4.55	4.55	3.22
B 27	1.007	-2.89	.00	.00
B 28	.974	2.16	.00	.00
B 29	.990	-3.70	3.12	1.26
B 30	.982	-4.07	9.62	3.78
C 3	1.005	39.68	3.12	1.68

C 4	.995	38.58	9.88	2.24
C 6	.997	37.36	.00	.00
C 7	.990	37.21	29.64	15.26
C 9	1.022	35.01	.00	.00
C 10	1.010	32.53	7.54	2.80
C 12	1.030	33.54	14.56	10.50
C 14	1.008	32.35	8.06	2.24
C 15	1.003	32.18	10.66	3.50
C 16	1.012	32.78	4.55	2.52
C 17	1.004	32.37	11.70	8.12
C 18	.989	31.35	4.16	1.26
C 19	.984	31.12	12.35	4.76
C 20	.990	31.39	2.86	.98
C 21	.994	31.92	22.75	15.68
C 22	.995	31.93	.00	.00
C 23	.990	31.61	4.16	2.24
C 24	.984	31.32	11.31	9.38
C 25	.996	31.42	.00	.00
C 26	.974	30.79	4.55	3.22
C 27	1.016	31.84	.00	.00
C 28	.990	35.97	.00	.00
C 29	.999	31.04	3.12	1.26
C 30	.992	30.68	9.62	3.78
D 3	.996	19.57	3.12	1.68
D 4	.991	19.52	9.88	2.24
D 6	.995	20.07	.00	.00
D 7	.989	20.96	29.64	15.26
D 9	1.021	17.49	.00	.00
D 10	1.010	14.89	7.54	2.80
D 12	1.027	15.21	14.56	10.50
D 14	1.006	14.13	8.06	2.24
D 15	1.002	14.05	10.66	3.50
D 16	1.010	14.75	4.55	2.52
D 17	1.003	14.63	11.70	8.12
D 18	.988	13.39	4.16	1.26
D 19	.984	13.26	12.35	4.76
D 20	.989	13.59	2.86	.98
D 21	.994	14.30	22.75	15.68
D 22	.995	14.32	.00	.00
D 23	.989	13.74	4.16	2.24
D 24	.983	13.79	11.31	9.38
D 25	.998	14.47	.00	.00
D 26	.975	13.84	4.55	3.22
D 27	1.018	15.23	.00	.00
D 28	.989	19.88	.00	.00
D 29	1.001	14.43	3.12	1.26
D 30	.994	14.07	9.62	3.78
E 4	.961	36.82	62.14	28.00
E 5	.974	40.17	9.88	2.24
E 7	1.006	32.70	.00	.00
E 9	.992	30.55	38.35	23.24
E 10	.988	30.39	11.70	8.12
11	1.005	30.95	4.55	2.52
12	1.009	30.62	7.93	2.24
13	1.001	30.51	17.55	8.12
14	.970	29.09	19.37	7.00

ower Generated:	7368.11	3636.81
wer Demanded:	7109.44	3605.14
stem Losses:	258.67	31.67

BUS 88	BUS 47	48.87	-7.84
BUS 88	BUS 48	33.28	-8.80
BUS 88	BUS 70	100.53	21.82
BUS 88	BUS 76	114.70	26.58
BUS 88	BUS 77	-18.81	33.83
BUS 88	BUS 88	-166.26	-84.22
	Total:	118.11	-28.83
BUS 1	BUS 2	-18.82	-8.83
BUS 1	BUS 3	-46.68	3.12
	Total:	-66.30	-2.81
BUS 4	BUS 8	-88.53	13.48
BUS 4	BUS 11	100.53	8.38
	Total:	11.01	21.86
BUS 8	BUS 6	-139.33	5.03
BUS 8	BUS 7	71.77	14.16
	Total:	-67.6[illegible]	18.18
BUS 8	BUS 9	-854.84	21.11
BUS 8	BUS 30	85.45	37.30
BUS 8	BUS 5	489.48	155.77
	Total:	40.00	214.18
BUS 10	BUS 9	570.00	80.88
	Total:	570.00	80.88
BUS 12	BUS 11	-74.32	43.33
BUS 12	BUS 2	43.14	16.45
BUS 12	BUS 3	13.58	8.84
BUS 12	BUS 7	-5.17	5.21
BUS 12	BUS 14	16.84	3.91
BUS 12	BUS 16	3.57	5.40
BUS 12	BUS 117	26.26	8.04
	Total:	23.60	82.00
BUS 15	BUS 13	2.88	2.88
BUS 15	BUS 14	1.43	-3.13
BUS 15	BUS 17	-131.78	-11.62
BUS 15	BUS 19	26.51	-2.11
BUS 15	BUS 33	-16.14	8.18
	Total:	-117.00	-8.00
BUS 16	BUS 17	-106.44	-11.31
BUS 16	BUS 16	30.44	5.36
	Total:	-76.00	-5.85
BUS 18	BUS 16	-30.32	-5.63
BUS 19	BUS 20	36.62	-41.82
BUS 19	BUS 15	-26.40	1.51
BUS 15	BUS 34	-36.38	3.04
	Total:	-56.50	-43.00
BUS 24	BUS 23	86.74	-.46
BUS 24	BUS 70	-12.64	.62
BUS 24	BUS 72	-37.81	14.81
	Total:	49.00	14.66
BUS 26	BUS 23	226.63	65.01
BUS 26	BUS 27	162.48	36.37
BUS 26	BUS 26	-172.08	-14.84
	Total:	220.01	86.44
BUS 26	BUS 30	247.82	-2.48
BUS 26	BUS 26	172.06	26.26
	Total:	420.00	22.42
BUS 27	BUS 26	-154.37	-1.01
BUS 27	BUS 26	50.06	1.73
BUS 27	BUS 32	56.64	-10.74
BUS 27	BUS 115	64.66	5.89
	Total:	16.00	-4.12
BUS 31	BUS 17	-30.26	-6.80
BUS 31	BUS 26	4.04	26.10
BUS 31	BUS 32	-22.66	8.07
	Total:	-48.80	27.47
BUS 32	BUS 23	-101.06	16.40
BUS 32	BUS 31	22.66	-11.63
BUS 32	BUS 27	-67.77	11.76
BUS 32	BUS 113	-8.46	-13.36
BUS 32	BUS 114	7.52	12.26
BUS 32	B 26	51.16	-16.17

	Total:	-78.70	-.71
BUS 34	BUS 18	38.43	-5.84
BUS 34	BUS 35	35.81	12.13
BUS 34	BUS 37	-156.26	-5.18
BUS 34	BUS 43	9.84	-.17
BUS 34	BUS 34	.00	-13.83
	Total:	-78.70	-12.41
BUS 36	BUS 36	-4.81	12.46
BUS 36	BUS 34	-36.39	-12.28
	Total:	-40.30	.18
BUS 40	BUS 37	15.53	-17.44
BUS 40	BUS 38	38.78	-6.70
BUS 40	BUS 41	12.03	8.18
BUS 40	BUS 42	-23.85	-2.44
BUS 40	A 8	11.31	-42.38
	Total:	54.00	-90.80
BUS 42	BUS 40	23.98	-.83
BUS 42	BUS 41	36.98	3.46
BUS 42	BUS 46	-35.37	-8.59
BUS 42	BUS 46	-35.37	-8.58
BUS 42	A 28	51.98	-12.46
	Total:	41.80	-23.12
BUS 46	BUS 46	71.87	32.42
BUS 46	BUS 47	-11.58	46.27
BUS 46	BUS 48	-7.48	18.71
BUS 46	BUS 46	.00	-11.38
	Total:	52.80	86.00
BUS 48	BUS 47	48.31	1.88
BUS 48	BUS 42	38.30	2.08
BUS 48	BUS 42	38.30	2.08
BUS 48	BUS 46	72.56	-10.10
BUS 48	BUS 48	58.84	-38.80
BUS 48	BUS 60	59.43	8.37
BUS 48	BUS 51	88.88	13.28
BUS 48	BUS 54	40.88	7.44
BUS 48	BUS 54	40.38	5.86
BUS 48	BUS 58	-121.88	1.08
BUS 48	BUS 56	-121.86	1.08
BUS 48	BUS 86	-32.23	4.14
	Total:	186.80	-1.08
BUS 54	BUS 53	17.56	6.28
BUS 54	BUS 48	-38.46	-8.88
BUS 54	BUS 48	-38.88	-8.08
BUS 54	BUS 56	7.50	-1.20
BUS 54	BUS 58	-24.72	-12.48
BUS 54	BUS 58	-20.82	-4.08
	Total:	-88.80	-26.46
BUS 56	BUS 54	-7.48	-.88
BUS 56	BUS 58	-48.84	-3.32
BUS 56	BUS 58	-24.57	-3.82
	Total:	-81.80	-7.80
BUS 58	BUS 54	24.76	12.28
BUS 58	BUS 86	48.87	3.37
BUS 58	BUS 67	-20.02	-2.28
BUS 58	BUS 58	-3.82	1.46
BUS 58	BUS 56	-17.81	-1.84
BUS 58	BUS 58	-18.44	-1.21
BUS 58	D 1	-124.22	-73.28
	Total:	-108.20	-81.20
BUS 58	BUS 64	21.05	-.87
BUS 58	BUS 58	17.88	-3.08
BUS 58	BUS 58	18.73	-3.08
BUS 56	BUS 56	24.87	-.18
BUS 58	BUS 60	-44.08	8.80
BUS 58	BUS 61	-85.84	8.31
BUS 58	D 28	3.48	-4.41
BUS 58	BUS 63	-181.18	-47.72
	Total:	-208.10	-44.10
BUS 61	BUS 58	58.52	-5.18
BUS 61	BUS 60	148.82	37.48
BUS 61	BUS 62	51.63	-11.74
BUS 61	BUS 64	-84.47	-3.73
	Total:	180.00	16.81
BUS 62	BUS 60	.87	15.02
BUS 62	BUS 61	-51.40	11.83
BUS 62	BUS 58	-48.40	-14.77
BUS 62	BUS 87	-.17	-15.88
	Total:	-100.10	-3.80
BUS 86	BUS 38	241.90	3.74
BUS 86	BUS 84	288.88	45.88
BUS 86	BUS 88	-137.18	26.88

BUS 66	BUS 66	106.89	74.11
Total:		500.01	150.61
BUS 66	BUS 48	124.43	9.23
BUS 66	BUS 49	124.43	9.23
BUS 66	BUS 62	50.56	14.19
BUS 66	BUS 67	110.26	16.86
BUS 66	D 6	148.42	18.67
BUS 66	BUS 66	-106.86	-68.89
Total:		449.30	2.83
BUS 70	BUS 68	-87.55	-12.49
BUS 70	BUS 24	13.04	-8.66
BUS 70	BUS 71	-40.84	1.15
BUS 70	BUS 74	28.54	4.52
BUS 70	BUS 75	10.11	8.02
Total:		-85.50	-7.47
BUS 7[illegible]	BUS 24	38.77	-15.20
BUS 7[illegible]	BUS 71	4.23	-7.08
Total:		43.00	-23.28
BUS 73	BUS 71	37.00	.65
Total:		37.00	.65
BUS 74	BUS 70	-28.16	-6.47
BUS 74	BUS 75	-66.24	18.83
BUS 74	BUS 74	.00	-11.16
Total:		-88.40	1.20
BUS 75	BUS 77	-102.81	13.46
BUS 75	BUS 118	14.51	14.74
Total:		-88.40	28.20
BUS 77	BUS 76	106.03	.02
BUS 77	BUS 69	17.25	-36.40
BUS 77	BUS 75	76.41	1.36
BUS 77	BUS 78	36.10	36.76
BUS 77	BUS 80	-173.95	-3.44
BUS 77	BUS 80	-81.74	-7.63
BUS 77	BUS 82	-80.40	40.53
Total:		-76.30	31.22
BUS 80	BUS 77	179.03	18.21
BUS 80	BUS 77	83.88	12.22
BUS 80	BUS 79	110.06	32.02
BUS 80	BUS 66	-2.16	26.16
BUS 80	BUS 67	-20.10	37.80
BUS 80	BUS 96	26.44	57.66
BUS 80	BUS 96	-36.06	20.16
BUS 80	BUS 81	94.06	-68.34
Total:		431.00	142.02
BUS 85	BUS 83	46.06	-.39
BUS 85	BUS 84	44.73	2.62
BUS 85	BUS 66	23.50	-6.23
BUS 85	BUS 66	-86.67	19.70
BUS 85	BUS 89	-114.00	-11.76
BUS 85	C 6	62.16	-2.14
Total:		-31.20	2.00
BUS 87	BUS 66	4.00	-16.66
Total:		4.00	-16.66
BUS 89	BUS 65	117.01	1.22
BUS 89	BUS 66	162.64	33.74
BUS 66	BUS 90	46.01	26.20
BUS 89	BUS 90	63.73	54.64
BUS 66	BUS 92	207.16	22.36
BUS 66	BUS 92	96.72	1.66
BUS 66	C 2	76.76	-10.06
Total:		750.00	126.06
BUS 90	BUS 66	-43.70	-26.64
BUS 90	BUS 66	-61.56	-46.64
BUS 90	BUS 91	-6.77	.73
BUS 90	E 6	146.62	-22.46
Total:		16.60	-66.31
BUS 91	BUS 90	6.76	-2.76
BUS 91	BUS 62	14.22	-36.96
Total:		20.00	-42.43
BUS 62	BUS 69	-203.26	-3.66
BUS 62	BUS 69	-64.16	-.03
BUS 62	BUS 91	-13.66	26.50
BUS 62	BUS 93	73.17	7.46
BUS 92	BUS 94	66.00	2.36
BUS 92	BUS 100	26.51	-4.73
BUS 92	BUS 102	26.76	-16.11

BUS 82	C 1	3.78	-31.47
+			
	Total:	-84.50	-8.00
BUS 88	BUS 80	38.82	-22.02
BUS 88	BUS 100	-4.82	-2.25
+			
	Total:	35.00	-24.27
BUS 100	BUS 82	-28.37	-1.35
BUS 100	BUS 84	48.17	21.08
BUS 100	BUS 88	90.15	12.44
BUS 100	BUS 88	4.83	.57
BUS 100	BUS 101	-13.07	5.74
BUS 100	BUS 103	108.81	4.28
BUS 100	BUS 104	56.83	10.83
BUS 100	BUS 108	82.35	17.05
+			
	Total:	301.80	70.31
BUS 103	BUS 100	-107.07	.11
BUS 103	BUS 104	36.54	8.88
BUS 103	BUS 105	45.35	10.47
BUS 103	BUS 110	35.28	11.34
+			
	Total:	10.10	27.80
BUS 104	BUS 100	-55.34	-8.25
BUS 104	BUS 103	-35.88	-7.42
BUS 104	BUS 105	41.84	28.05
+			
	Total:	-49.40	8.38
BUS 107	BUS 105	.80	10.10
BUS 107	BUS 108	7.80	15.28
BUS 107	BUS 107	.00	-5.78
+			
	Total:	8.60	19.58
BUS 111	BUS 110	38.00	12.44
+			
	Total:	38.00	12.44
BUS 112	BUS 110	22.50	10.28
+			
	Total:	22.50	10.28
BUS 119	BUS 88	210.00	84.88
	Total:	210.00	84.88
A 1	A 2	81.88	3.82
A 1	A 3	42.13	15.02
A 1	BUS 48	-23.88	15.15
	Total:	100.00	33.79
A 2	A 1	-80.88	-2.88
A 2	A 4	28.84	10.78
A 2	A 5	48.08	10.37
A 2	A 6	30.87	12.33
A 2	BUS 45	26.78	31.70
	Total:	51.78	62.22
A 5	A 2	-45.08	-8.32
A 5	A 7	-4.04	8.84
A 5	BUS 44	-23.32	7.34
	Total:	-72.48	7.85
A 8	A 8	-1.41	-3.84
A 8	A 28	-8.53	4.08
A 8	BUS 40	-11.08	42.88
	Total:	-19.00	43.00
11	A 8	20.00	18.27
	Total:	20.00	18.27
12	A 12	20.00	18.55
	Total:	20.00	18.85
1	B 2	45.44	3.82
1	B 3	28.87	16.87
1	BUS 20	27.88	77.31
	Total:	100.00	100.00
2	B 1	-45.07	-5.58
2	B 4	18.83	17.52
2	B 8	55.87	11.33
2	B 5	21.88	18.88
	Total:	51.78	42.22

B 5	B 2	-84.15	-7.48
B 5	B 7	-18.31	15.33
	Total:	-72.46	7.85
B 8	B 5	23.74	-6.58
B 8	B 28	-4.14	5.35
B 8	BUS 22	-38.81	33.22
	Total:	-19.00	32.00
B 11	B 9	20.00	17.72
	Total:	20.00	17.72
B 13	B 12	20.00	18.78
	Total:	20.00	18.78
C 1	C 2	45.65	-4.36
C 1	C 3	87.88	12.75
C 1	BUS 82	-3.80	30.87
	Total:	100.00	38.27
C 2	C 1	-45.26	2.56
C 2	C 4	58.15	9.22
C 2	C 5	46.35	7.34
C 2	C 9	96.73	5.69
C 2	BUS 88	-75.15	17.42
	Total:	81.76	42.22
C 5	C 2	-45.38	-5.50
C 5	C 7	24.66	4.27
C 5	BUS 85	-51.77	2.84
	Total:	-72.46	1.81
C 8	C 9	-30.33	20.76
C 8	C 28	5.76	3.06
C 8	BUS 83	5.55	9.15
	Total:	-19.00	33.00
C 11	C 9	20.00	14.81
	Total:	20.00	14.81
C 13	C 12	20.00	18.51
	Total:	20.00	18.51
D 1	D 2	-35.70	8.28
D 1	D 3	8.85	8.48
D 1	BUS 55	128.74	81.28
	Total:	100.00	100.00
D 2	D 1	35.85	-11.24
D 2	D 4	23.05	9.81
D 2	D 5	-24.28	10.54
D 2	D 6	17.07	5.80
	Total:	81.76	11.72
D 5	D 2	24.52	-11.31
D 5	D 7	44.85	-.38
D 5	BUS 86	-142.08	-8.77
	Total:	-72.46	-18.46
D 8	D 5	40.08	13.88
D 8	D 28	10.88	4.06
D 8	BUS 87	-68.82	14.86
	Total:	-19.00	33.00
11	D 9	20.00	14.86
	Total:	20.00	14.89
13	D 12	20.00	17.28
	Total:	20.00	17.28
1	E 2	176.75	18.37
1	E 5	48.68	23.78
1	BUS 102	48.38	31.04
	Total:	274.00	73.20
2	E 1	-170.27	-3.71
2	E 3	80.24	11.44
2	E 4	38.38	15.89
2	E 5	8.84	18.50
2	BUS 87	88.48	-8.80

	Total:	11.78	32.22
E 3	E 2	-77.21	-2.92
E 3	E 4	-45.25	18.32
	Total:	-122.46	15.40
E 8	E 11	12.13	8.38
E 8	E 12	10.63	3.98
E 8	E 13	24.61	12.10
E 8	E 9	-51.83	-.86
	Total:	-14.56	23.60
E 8	E 7	.00	26.38
	Total:	.00	26.38
BUS 2	BUS 1	15.72	3.88
BUS 2	BUS 12	-42.72	-16.64
	Total:	-26.00	-12.86
BUS 3	BUS 1	50.03	-2.83
BUS 3	BUS 5	-101.63	-13.13
BUS 3	BUS 12	-13.41	-11.83
	Total:	-65.00	-27.88
BUS 5	BUS 4	88.87	-13.05
BUS 5	BUS 3	104.40	22.87
BUS 5	BUS 8	141.73	4.47
BUS 5	BUS 11	111.86	7.57
BUS 5	BUS 8	-488.48	-66.93
BUS 5	BUS 6	.00	38.86
	Total:	-62.00	-26.18
BUS 7	BUS 6	-71.46	-13.53
BUS 7	BUS 12	5.16	-5.03
	Total:	-66.30	-18.56
BUS 8	BUS 6	582.28	20.04
BUS 8	BUS 10	-582.28	-20.03
	Total:	.00	.00
BUS 11	BUS 4	-98.38	-3.02
BUS 11	BUS 5	-109.12	-.66
BUS 11	BUS 12	74.76	-42.26
BUS 11	BUS 13	41.73	13.81
	Total:	-91.00	-32.17
BUS 13	BUS 11	-41.27	-14.04
BUS 13	BUS 15	-2.93	-8.38
	Total:	-44.20	-22.40
BUS 14	BUS 12	-18.77	-5.41
BUS 14	BUS 15	-1.43	-1.56
	Total:	-18.20	-8.98
BUS 18	BUS 12	-3.58	-7.38
BUS 18	BUS 17	-28.84	-8.81
	Total:	-32.50	-13.88
BUS 17	BUS 15	134.22	18.44
BUS 17	BUS 18	28.38	3.76
BUS 17	BUS 16	108.96	19.38
BUS 17	BUS 31	30.77	8.37
BUS 17	BUS 113	17.44	-.73
BUS 17	BUS 30	-338.08	-48.41
BUS 17	BUS 17	.00	.00
	Total:	-14.30	-4.18
BUS 20	BUS 18	-34.84	42.33
BUS 20	BUS 21	38.52	22.78
BUS 20	B 1	-27.08	-74.88
	Total:	-23.40	-9.78
BUS 21	BUS 20	-38.15	-23.18
BUS 21	BUS 22	-30.11	18.31
BUS 21	B 4	11.08	-18.13
	Total:	-57.20	-21.00
BUS 22	BUS 21	30.38	-18.35
BUS 22	BUS 23	-128.14	24.61
BUS 22	B 8	39.24	-33.35
	Total:	-58.50	-18.19

BUS 23	BUS 22	134.81	-8.25
BUS 23	BUS 24	-86.38	4.02
BUS 23	BUS 25	-221.55	-25.51
BUS 23	BUS 32	104.73	-8.36
+			
	Total:	-80.80	-38.20

BUS 26	BUS 27	-49.56	-1.44
BUS 26	BUS 28	27.46	-5.36
+			
	Total:	-22.10	-6.80

BUS 28	BUS 29	-27.24	7.01
BUS 28	BUS 31	-3.88	-25.81
+			
	Total:	-31.20	-18.80

BUS 30	BUS 6	-84.80	-82.03
BUS 30	BUS 26	-243.00	-34.92
BUS 30	BUS 38	1.93	22.95
BUS 30	BUS 17	336.08	83.70
+			
	Total:	.00	.00

BUS 33	BUS 15	18.31	-10.61
BUS 33	BUS 37	-48.21	-1.88
+			
	Total:	-29.80	-12.50

BUS 35	BUS 36	4.92	-12.69
BUS 35	BUS 37	-47.82	-13.88
+			
	Total:	-42.90	-26.57

BUS 37	BUS 35	48.10	13.80
BUS 37	BUS 33	48.24	2.05
BUS 37	BUS 34	186.65	7.35
BUS 37	BUS 39	-3.24	19.64
BUS 37	BUS 40	-15.22	14.27
BUS 37	BUS 38	-237.54	-81.49
BUS 37	BUS 37	.00	24.40
+			
	Total:	.00	.03

BUS 39	BUS 30	-1.74	-81.47
BUS 38	BUS 35	-238.11	-44.30
BUS 38	BUS 37	237.84	105.77
+			
	Total:	-.01	.00

BUS 39	BUS 37	3.36	-21.83
BUS 38	BUS 40	-38.48	6.23
	Total:	-35.10	-15.60

BUS 41	BUS 40	-12.00	-9.18
BUS 41	BUS 42	-36.10	-4.81
	Total:	-48.10	-14.00

BUS 43	BUS 44	-13.60	-8.06
BUS 43	BUS 34	-9.80	-3.71
	Total:	-23.40	-8.80

BUS 44	BUS 43	13.63	.72
BUS 44	BUS 45	-56.17	7.50
BUS 44	A 5	23.44	-8.55
BUS 44	BUS 44	.00	-8.87
	Total:	-20.80	-11.20

BUS 45	BUS 44	56.65	-8.57
BUS 45	BUS 46	-86.45	-28.48
BUS 45	BUS 48	-86.08	14.88
BUS 45	A 2	-28.31	-32.85
BUS 45	BUS 45	.00	-10.00
	Total:	-107.80	-83.00

BUS 47	BUS 48	12.38	-48.87
BUS 47	BUS 48	-47.88	-1.88
BUS 47	BUS 88	-47.71	8.83
	Total:	-83.20	-42.00

BUS 48	BUS 48	7.78	-23.07
BUS 48	BUS 48	-58.10	38.83
BUS 48	A 1	24.34	-18.12
BUS 48	BUS 48	.00	-15.04
	Total:	-26.00	-15.40

BUS 50	BUS 48	-55.50	-5.58
BUS 50	BUS 57	35.40	3.08
	Total:	-22.10	-8.50

BUS 51	BUS 48	-87.82	-10.00
BUS 51	BUS 52	38.23	7.88

BUS 51	BUS 58	18.33	-.82
BUS 51	D 4	-10.04	-8.14
	Total:	-22.10	-11.20
BUS 52	BUS 51	-35.83	-8.32
BUS 52	BUS 53	12.83	1.32
	Total:	-23.40	-7.00
BUS 53	BUS 52	-12.46	-4.75
BUS 53	BUS 54	-17.44	-10.65
	Total:	-29.90	-15.40
BUS 57	BUS 55	20.17	.38
BUS 57	BUS 60	-35.77	-4.58
	Total:	-15.60	-4.20
BUS 58	BUS 58	3.63	-3.71
BUS 58	BUS 51	-19.23	-.49
	Total:	-15.60	-4.20
BUS 80	BUS 59	44.75	-8.19
BUS 80	BUS 81	-145.32	-34.99
BUS 80	BUS 82	-.83	-16.32
	Total:	-101.40	-60.20
BUS 83	BUS 84	-191.19	-63.17
BUS 83	BUS 59	191.18	63.17
	Total:	.00	.00
BUS 84	BUS 83	191.89	51.11
BUS 84	BUS 85	-286.36	-57.28
BUS 84	BUS 81	94.47	6.15
	Total:	.00	.00
BUS 87	BUS 82	.22	12.79
BUS 87	BUS 88	-107.71	-10.28
BUS 87	D 8	71.08	-12.33
	Total:	-36.40	-9.80
BUS 88	BUS 55	137.46	-48.99
BUS 88	BUS 81	-93.80	32.48
BUS 88	BUS 118	-208.83	-88.54
BUS 88	BUS 88	166.24	108.84
	Total:	.00	.00
BUS 71	BUS 70	41.08	-1.40
BUS 71	BUS 72	-4.21	2.88
BUS 71	BUS 73	-36.88	-1.47
	Total:	.00	.00
BUS 75	BUS 70	-10.01	-12.12
BUS 75	BUS 88	-108.41	-14.70
BUS 75	BUS 74	58.75	-18.10
BUS 75	BUS 77	-72.83	5.32
BUS 75	BUS 118	28.80	4.58
	Total:	-104.00	-35.00
BUS 76	BUS 77	-35.01	-35.83
BUS 76	BUS 78	-57.29	-.57
	Total:	-92.30	-36.40
BUS 78	BUS 78	57.47	.72
BUS 78	BUS 80	-106.17	-25.37
BUS 78	BUS 76	.00	-20.14
	Total:	-50.70	-44.80
BUS 81	BUS 88	94.08	-43.57
BUS 81	BUS 80	-94.08	83.57
	Total:	.00	.00
US 82	BUS 77	81.88	-38.87
US 82	BUS 83	-55.76	.25
US 82	BUS 88	-50.80	12.04
US 82	C 28	-25.83	8.38
US 82	BUS 82	.00	-19.81
	Total:	-70.20	-37.80
US 83	BUS 82	58.11	-.22
US 83	BUS 84	-28.48	5.58
US 83	BUS 85	-47.12	.18
US 83	C 6	-5.53	-8.82
US 83	BUS 83	.00	-9.83
	Total:	-28.00	-14.00

BUS 84	BUS 83	29.84	-6.87
BUS 84	BUS 88	-44.24	-2.83
+			
Total:		-14.30	-9.80
BUS 86	BUS 85	-23.30	4.07
BUS 86	BUS 87	-4.00	-18.07
+			
Total:		-27.30	-14.00
BUS 88	BUS 85	87.18	-14.87
BUS 88	BUS 89	-149.58	-20.13
+			
Total:		-62.40	-35.00
BUS 93	BUS 92	-71.85	-5.37
BUS 93	BUS 94	56.25	-4.43
+			
Total:		-15.60	-9.80
BUS 94	BUS 92	-84.01	.00
BUS 94	BUS 93	-55.85	4.85
BUS 94	BUS 95	71.72	6.42
BUS 94	BUS 96	56.53	-12.31
BUS 94	BUS 100	-47.88	-21.38
+			
Total:		-38.00	-22.40
BUS 95	BUS 94	-71.03	-5.24
BUS 95	BUS 96	31.75	-24.45
BUS 96	C 4	-15.33	-13.87
+			
Total:		-54.60	-43.40
BUS 98	BUS 80	2.43	-28.84
BUS 98	BUS 92	51.05	-12.21
BUS 98	BUS 94	-65.53	12.95
BUS 98	BUS 95	-31.48	23.84
BUS 98	BUS 97	-15.77	-18.74
Total:		-49.40	-21.00
BUS 97	BUS 80	20.43	-36.81
BUS 97	BUS 96	18.88	14.78
BUS 97	E 2	-85.78	11.23
Total:		-15.60	-12.80
BUS 94	BUS 80	-24.52	-58.89
BUS 94	BUS 100	-88.68	-10.51
Total:		-83.20	-87.20
BUS 101	BUS 100	13.13	-8.83
BUS 101	BUS 102	-41.73	-12.17
Total:		-28.60	-21.00
BUS 102	BUS 92	-26.55	18.08
BUS 102	BUS 101	42.18	11.12
BUS 102	E 1	-48.03	-30.37
Total:		-32.50	-4.20
BUS 105	BUS 103	-44.18	-10.75
BUS 105	BUS 104	-41.58	-25.98
BUS 105	BUS 106	22.38	17.18
BUS 105	BUS 107	-.72	-14.23
BUS 105	BUS 108	23.77	4.48
BUS 105	BUS 105	.00	-18.30
Total:		-40.30	-47.80
BUS 109	BUS 100	-58.84	-13.80
BUS 109	BUS 108	-22.27	-17.88
BUS 109	BUS 107	-7.59	-18.82
Total:		-88.70	-80.40
BUS 108	BUS 105	-23.80	-5.71
BUS 108	BUS 109	21.00	4.31
Total:		-2.80	-1.40
BUS 109	BUS 108	-20.85	-4.83
BUS 109	BUS 110	-41.45	-9.17
Total:		-82.40	-14.00
BUS 110	BUS 103	-34.72	-13.27
BUS 110	BUS 109	42.01	8.87
BUS 110	BUS 111	-35.86	-13.17
BUS 110	BUS 112	-22.33	-12.02
BUS 110	BUS 110	.00	-5.85
Total:		-50.70	-35.14

BUS 113	BUS 17	-17.42	.06
BUS 113	BUS 32	9.62	8.80
Total:		-7.80	8.86
BUS 114	BUS 32	-7.58	-13.83
BUS 114	BUS 115	-18.41	8.43
Total:		-26.00	-4.20
BUS 115	BUS 27	-63.82	-4.37
BUS 115	BUS 114	18.42	-8.63
Total:		-45.50	-14.00
BUS 117	BUS 12	-28.00	-11.20
Total:		-28.00	-11.20
BUS 118	BUS 75	-28.47	-5.26
BUS 118	BUS 76	-14.43	-15.74
Total:		-42.60	-21.00
A 3	A 1	-41.30	-13.75
A 3	A 4	38.18	12.07
Total:		-3.12	-1.68
A 4	A 2	-26.15	-15.19
A 4	A 3	-37.87	-12.76
A 4	A 6	18.60	7.42
A 4	A 12	34.64	18.28
Total:		-8.68	-2.24
A 6	A 2	-30.32	-18.28
A 6	A 4	-18.55	-7.68
A 6	A 7	34.07	.54
A 6	A 8	1.41	3.60
A 6	A 28	-21.65	18.87
A 6	A 9	20.41	-2.42
A 6	A 10	15.63	3.46
Total:		.00	.00
A 7	A 5	4.11	-13.08
A 7	A 6	-33.75	-2.17
Total:		-28.64	-15.26
A 8	A 11	-20.00	-15.02
A 8	A 10	40.41	11.74
A 8	A 9	-20.41	3.28
Total:		.00	.00
A 10	A 9	-40.41	-9.86
A 10	A 20	12.08	4.32
A 10	A 17	8.16	5.17
A 10	A 21	16.22	13.10
A 10	A 22	8.05	5.85
A 10	A 6	-15.63	-2.11
A 10	A 10	.00	-18.27
Total:		-7.54	-2.60
A 12	A 13	-20.00	-15.78
A 12	A 14	9.88	4.18
A 12	A 15	21.87	10.21
A 12	A 16	8.23	5.77
A 12	A 4	-34.64	-14.84
Total:		-14.58	-10.50
A 14	A 12	-8.75	-3.88
A 14	A 15	1.68	1.64
Total:		-8.08	-2.24
A 15	A 12	-21.80	-8.48
A 15	A 14	-1.68	-1.83
A 15	A 16	7.58	3.28
A 15	A 23	5.07	4.37
Total:		-10.83	-3.50
A 16	A 12	-8.14	-5.58
A 16	A 17	3.58	3.08
Total:		-4.55	-2.52
A 17	A 18	-3.57	-3.02
A 17	A 10	-8.13	-8.10
Total:		-11.70	-8.12
A 18	A 15	-7.48	-3.10
A 18	A 19	3.32	1.64

	Total:	-4.18	-1.26
A 19	A 18	-3.31	-1.82
A 19	A 20	-8.04	-2.94
	Total:	-12.36	-4.76
A 20	A 19	8.07	3.00
A 20	A 10	-11.93	-3.88
	Total:	-2.86	-.98
A 21	A 10	-18.03	-12.71
A 21	A 22	-3.72	-2.97
	Total:	-22.76	-18.68
A 22	A 10	-8.98	-5.58
A 22	A 21	3.72	2.98
A 22	A 24	5.24	2.70
	Total:	.00	.00
A 23	A 19	-5.02	-4.28
A 23	A 24	.85	2.04
	Total:	-4.16	-2.24
A 24	A 22	-5.20	-2.84
A 24	A 23	-.88	-2.03
A 24	A 25	-5.25	-.67
A 24	A 24	.00	-3.85
	Total:	-11.31	-8.38
A 25	A 24	5.30	.67
A 25	A 26	4.82	3.36
A 25	A 27	-8.82	-4.31
	Total:	.00	.00
A 26	A 25	-4.85	-3.22
	Total:	-4.85	-3.22
A 27	A 25	10.05	4.85
A 27	A 29	8.87	2.34
A 27	A 30	7.28	3.05
A 27	A 26	-22.98	-8.88
	Total:	.00	.00
A 28	A 8	21.60	-18.98
A 28	A 8	8.58	-8.02
A 28	BUS 42	-51.38	12.84
A 28	A 27	22.58	12.38
	Total:	.00	.00
A 28	A 27	-5.81	-2.23
A 28	A 30	2.48	.87
	Total:	-3.12	-1.26
A 30	A 27	-7.14	-2.84
A 30	A 29	-2.48	-.84
	Total:	-9.62	-3.76
B 3	B 1	-28.21	-18.13
B 3	B 4	23.08	17.45
	Total:	-3.12	-1.68
B 4	B 2	-18.20	-22.05
B 4	B 3	-22.69	-18.40
B 4	B 6	8.38	7.48
B 4	BUS 21	-10.87	13.83
B 4	B 12	33.88	18.80
	Total:	-9.88	-2.24
B 6	B 2	-21.14	-23.31
B 6	B 4	-8.38	-7.88
B 6	B 7	48.81	-4.13
B 6	B 6	-23.87	8.41
B 6	B 26	-31.11	26.88
B 6	B 9	20.83	-3.23
B 6	B 10	15.74	3.25
	Total:	.00	.01
B 7	B 5	18.81	-18.84
B 7	B 8	-48.25	3.59
	Total:	-29.84	-18.26

B 9	B 10	40.83	12.25
B 9	B 9	-20.83	4.13
Total:		.00	.00
B 10	B 9	-40.83	-10.33
B 10	B 20	12.23	4.22
B 10	B 17	8.47	4.80
B 10	B 21	10.13	13.38
B 10	B 22	5.89	8.03
B 10	B 8	-15.74	-1.87
B 10	B 10	.00	-10.14
Total:		-7.84	-2.80
B 12	B 13	-20.00	-17.83
B 12	B 14	8.78	4.27
B 12	B 15	21.83	10.59
B 12	B 16	7.81	8.03
B 12	B 4	-33.88	-13.56
Total:		-14.66	-10.50
B 14	B 12	-9.85	-3.99
B 14	B 15	1.59	1.75
Total:		-8.06	-2.24
B 15	B 12	-21.27	-9.87
B 15	B 14	-1.56	-1.74
B 15	B 18	7.41	3.38
B 15	B 23	4.76	4.76
Total:		-10.56	-3.50
B 18	B 12	-7.82	-5.84
B 18	B 17	3.27	3.32
Total:		-4.55	-2.52
B 17	B 15	-3.25	-3.25
B 17	B 10	-8.44	-4.84
Total:		-11.70	-8.12
B 18	B 15	-7.34	-3.21
B 18	B 19	3.18	1.95
Total:		-4.16	-1.26
B 19	B 18	-3.17	-1.93
B 19	B 20	-9.18	-2.83
Total:		-12.35	-4.76
B 20	B 19	9.22	2.89
B 20	B 10	-12.08	-3.87
Total:		-2.86	-.98
B 21	B 10	-18.86	-12.87
B 21	B 22	-3.80	-2.71
Total:		-22.76	-15.58
B 22	B 10	-8.91	-5.88
B 22	B 21	3.81	2.71
B 22	B 24	5.10	3.18
Total:		.00	.00
B 23	B 15	-4.74	-4.65
B 23	B 24	.58	2.42
Total:		-4.16	-2.24
B 24	B 22	-5.06	-3.08
B 24	B 23	-.67	-2.40
B 24	B 25	-5.58	-.09
B 24	B 24	.00	-3.81
Total:		-11.31	-9.38
B 25	B 24	5.75	.20
B 25	B 26	4.82	3.25
B 25	B 27	-10.37	-3.54
Total:		.00	.00
I 28	B 25	-4.55	-3.22
Total:		-4.55	-3.22
I 27	B 25	10.50	3.80
I 27	B 28	6.67	2.35
I 27	B 30	7.28	3.06
I 27	B 28	-23.44	-9.21
Total:		.00	.00

B 25	B 4	31.43	-28.38
B 25	B 6	4.19	-8.26
B 25	BUS_32	-68.04	24.87
B 25	B 27	23.44	11.88
Total:		.00	.00

B 28	B 27	-5.61	-2.23
B 28	B 30	2.48	.97
Total:		-3.12	-1.28

B 30	B 27	-7.14	-2.84
B 30	B 28	-2.48	-.94
Total:		-9.62	-3.78

C 3	C 1	-58.49	-8.85
C 3	C 4	53.37	7.27
Total:		-3.12	-1.58

C 4	C 2	-58.30	-8.51
C 4	C 3	-52.89	-7.47
C 4	C 6	46.31	-15.92
C 4	BUS_85	15.41	13.01
C 4	C 12	37.70	17.85
Total:		-9.68	-2.24

C 5	C 2	-88.17	-3.84
C 5	C 4	-48.02	18.47
C 5	C 7	5.26	4.71
C 5	C 8	30.49	-20.94
C 5	C 26	40.14	.32
C 5	C 9	20.55	-.88
C 5	C 10	15.74	4.04
Total:		.00	.00

C 7	C 5	-24.40	-7.85
C 7	C 9	-5.26	-7.30
Total:		-28.64	-15.26

C 8	C 11	-20.00	-13.45
C 8	C 10	40.58	11.84
C 8	C 5	-20.58	1.61
Total:		.00	.00

C 10	C 9	-40.58	-9.75
C 10	C 20	11.85	4.76
C 10	C 17	7.08	8.07
C 10	C 21	20.28	12.84
C 10	C 22	8.74	5.84
C 10	C 5	-15.74	-2.65
C 10	C 10	.00	-18.40
Total:		-7.54	-2.60

C 12	C 13	-20.00	-14.70
C 12	C 14	10.33	3.68
C 12	C 15	23.50	9.19
C 12	C 18	8.32	4.88
C 12	C 4	-37.70	-13.75
Total:		-14.56	-10.50

C 14	C 12	-10.18	-3.59
C 14	C 15	2.12	1.35
Total:		-8.06	-2.24

C 15	C 12	-23.10	-8.41
C 15	C 14	-2.12	-1.33
C 15	C 18	7.88	2.80
C 15	C 23	8.58	3.44
Total:		-10.88	-3.50

C 16	C 12	-8.22	-4.68
C 16	C 17	4.67	2.18
Total:		-4.56	-2.52

C 17	C 18	-4.65	-2.11
C 17	C 10	-7.05	-8.01
Total:		-11.70	-8.12

C 18	C 15	-7.80	-2.85
C 18	C 16	3.74	1.38
Total:		-4.16	-1.28

C 19	C 16	-3.73	-1.36
C 19	C 20	-8.82	-3.40
Total:		-12.35	-4.76

C 20	C 19	6.85	3.48
C 20	C 10	-11.51	-4.44
Total:		-2.66	-.96
C 21	C 10	-20.06	-12.22
C 21	C 22	-2.66	-3.46
Total:		-22.76	-16.66
C 22	C 10	-6.66	-5.36
C 22	C 21	2.66	3.46
C 22	C 24	6.99	1.90
Total:		.00	.00
C 23	C 15	-6.52	-3.33
C 23	C 24	2.36	1.09
Total:		-4.16	-2.24
C 24	C 22	-6.63	-1.80
C 24	C 23	-2.35	-1.09
C 24	C 25	-2.03	-2.83
C 24	C 24	.00	-3.87
Total:		-11.31	-9.38
C 25	C 24	2.05	2.87
C 25	C 26	4.82	3.34
C 25	C 27	-6.87	-6.02
Total:		.00	.00
C 26	C 25	-4.55	-3.22
Total:		-4.55	-3.22
C 27	C 25	8.75	8.18
C 27	C 29	5.87	2.34
C 27	C 30	7.26	3.06
C 27	C 28	-18.89	-11.58
Total:		.00	.00
C 28	C 6	-38.87	.03
C 28	C 8	-5.75	-5.11
C 28	BUS 82	25.93	-8.49
C 28	C 27	18.68	13.58
Total:		.00	.00
C 29	C 27	-5.61	-2.23
C 29	C 30	2.48	.87
Total:		-3.12	-1.28
C 30	C 27	-7.14	-2.84
C 30	C 29	-2.48	-.94
Total:		-9.62	-3.78
D 3	D 1	-6.87	-11.18
D 3	D 4	5.75	9.61
Total:		-3.12	-1.88
D 4	D 2	-22.71	-11.33
D 4	D 3	-6.73	-10.73
D 4	D 6	-23.82	-2.77
D 4	BUS 81	10.11	6.26
D 4	D 12	32.08	18.34
Total:		-9.88	-2.24
D 6	D 2	-16.67	-11.08
D 6	D 4	23.98	2.87
D 6	D 7	-14.32	11.51
D 6	D 6	-38.85	-13.88
D 6	D 26	7.89	7.85
D 6	D 9	22.61	-1.23
D 6	D 10	18.85	3.84
Total:		.00	.00
D 7	D 5	-44.08	-1.43
D 7	D 9	14.42	-13.83
Total:		-29.84	-15.28
8	D 11	-20.00	-13.72
8	D 10	42.51	11.47
8	D 8	-22.51	2.28
Total:		.00	.00
10	D 9	-42.51	-8.42

D 10	D 20	12.67	4.48
D 10	D 17	9.48	5.43
D 10	D 21	19.94	12.83
D 10	D 22	9.52	6.67
D 10	D 6	-18.65	-2.37
D 10	D 10	.00	-18.38
Total:		-7.54	-2.80
D 12	D 13	-20.00	-18.40
D 12	D 14	8.81	4.04
D 12	D 15	21.03	8.81
D 12	D 16	8.86	5.46
D 12	D 4	-32.06	-13.41
Total:		-14.56	-10.50
D 14	D 12	-8.48	-3.77
D 14	D 15	1.42	1.53
Total:		-8.06	-2.24
D 15	D 12	-93.88	-8.14
D 15	D 14	1.42	-1.52
D 15	D 16	8.77	3.13
D 15	D 23	4.86	4.04
Total:		-10.86	-3.50
D 16	D 12	-8.81	-5.31
D 16	D 17	2.26	2.78
Total:		-4.56	-2.52
D 17	D 16	-2.26	-2.77
D 17	D 10	-8.46	-8.36
Total:		-11.70	-8.12
D 18	D 15	-8.71	-3.01
D 18	D 19	2.56	1.76
Total:		-4.16	-1.26
D 19	D 18	-2.54	-1.74
D 19	D 20	-9.81	-3.02
Total:		-12.36	-4.76
D 20	D 19	9.84	3.10
D 20	D 10	-12.70	-4.06
Total:		-2.86	-.96
D 21	D 10	-19.76	-12.42
D 21	D 22	-3.00	-3.26
Total:		-22.76	-15.66
D 22	D 10	-8.43	-5.49
D 22	D 21	3.01	3.27
D 22	D 24	5.42	2.22
Total:		.00	.00
D 23	D 15	-4.64	-3.86
D 23	D 24	.48	1.72
Total:		-4.16	-2.24
D 24	D 22	-8.37	-2.14
D 24	D 23	-.48	-1.71
D 24	D 25	-4.46	-1.87
D 24	D 24	.00	-3.87
Total:		-11.31	-9.36
D 25	D 24	4.51	1.74
D 25	D 26	4.62	3.34
D 25	D 27	-9.12	-5.08
Total:		.00	.00
26	D 25	-4.55	-3.22
Total:		-4.55	-3.22
27	D 25	9.24	5.32
27	D 29	5.67	2.34
27	D 30	7.26	3.05
27	D 28	-22.17	-10.71
Total:		.00	.00
28	D 6	-7.97	-8.51
28	D 8	-10.77	-5.90
28	BUS 59	-3.43	1.36
28	D 27	22.17	13.03
Total:		.00	.00

D 28	D 27	-5.81	-2.23
D 28	D 30	2.48	.87
+			
	Total:	-3.12	-1.28
D 30	D 27	-7.14	-2.84
D 30	D 28	-2.48	-.84
+			
	Total:	-9.82	-3.78
E 4	E 2	-37.37	-18.48
E 4	E 3	47.03	-18.88
E 4	E 9	-125.12	13.85
E 4	E 7	33.88	-8.47
E 4	E 8	19.33	1.08
+			
	Total:	-62.14	-26.00
E 5	E 1	-48.34	-22.40
E 5	E 2	-8.88	-21.08
E 5	L 4	127.41	-7.82
E 5	BUS 80	-144.20	38.03
E 5	E 6	81.93	10.04
+			
	Total:	-8.88	-2.24
E 7	E 8	.00	-25.28
E 7	E 9	33.88	13.11
E 7	E 4	-33.98	12.17
+			
	Total:	.00	.00
E 9	E 7	-33.98	-11.87
E 9	E 10	4.38	2.87
E 9	E 14	10.88	3.20
E 9	E 4	-18.33	1.06
E 9	E 8	.00	-18.70
+			
	Total:	-36.36	-23.24
E 10	E 9	-4.38	-2.84
E 10	E 11	-7.32	-5.28
+			
	Total:	-11.70	-8.12
E 11	E 9	-11.94	-7.85
E 11	E 10	7.38	5.44
+			
	Total:	-4.55	-2.82
E 12	E 9	-10.48	-3.88
E 12	E 13	2.55	1.45
+			
	Total:	-7.93	-2.24
E 13	E 9	-24.14	-11.18
E 13	E 12	-2.53	-1.43
E 13	E 14	9.12	4.49
	Total:	-17.55	-8.12
E 14	E 9	-10.43	-2.87
E 14	E 13	-8.94	-4.13
	Total:	-19.37	-7.00

System losses:	258.87	31.97
R*I**2,X*I**2:	258.87	1488.25

Appendix J

250 Bus Network

Contingency AI

J.1. Bus Oriented Results

```
    Time for input:  2.93
    Time for compact:   .26
    Time for factorization:   .30
No. of iterations:  5
Maximum mismatch (in pu):  3.4E-04 9.2E-04
    Time for solution:   .23
Execution time:  3.72

S base : 100.
```

Bus	Vsp	Voltage		Generation		QGmin	QGmax	Load	
BUS 69		1.035	30.00	852.37	-77.50				
BUS 1	.960	.960	-3.35	.00	13.11	-5.00	35.00	51.00	27.00
BUS 4	.998	.998	1.64	50.00	-8.54	-300.00	300.00	30.00	12.00
BUS 6	.990	.990	-1.07	.00	31.45	-13.00	50.00	52.00	22.00
BUS 8	1.015	1.015	6.42	40.00	93.29	-300.00	300.00	.00	10.00
BUS 10	1.055	1.055	13.76	225.00	8.30	-147.00	200.00	.00	.00
BUS 12	.990	.990	-1.32	85.00	112.29	-35.00	120.00	47.00	20.00
BUS 15	.970	.970	.80	.00	-2.80	-10.00	50.00	90.00	40.00
BUS 18	.973	.973	1.33	.00	9.79	-16.00	50.00	60.00	34.00
BUS 19	.960	.972+	.98	.00	-7.78	-8.00	24.00	45.00	25.00
BUS 24	.992	.992	16.76	49.00	-2.28	-300.00	300.00	.00	.00
BUS 25	1.050	1.050	19.41	220.00	74.37	-47.00	140.00	.00	.00
BUS 26	1.015	1.015	20.54	314.00	14.11	-1000.00	1000.00	.00	.00
BUS 27	.968	.968	8.52	45.00	-9.45	-300.00	300.00	20.00	13.00
BUS 31	.967	.967	3.97	7.00	41.43	-300.00	300.00	43.00	27.00
BUS 32	.963	.964+	6.21	.00	-9.73	-14.00	42.00	59.00	23.00
BUS 34	.984	.987+	3.21	.00	-.78	-8.00	24.00	59.00	26.00
BUS 36	.980	.980	2.82	.00	1.83	-8.00	24.00	31.00	17.00
BUS 40	.970	.970	1.87	-46.00	-36.37	-300.00	300.00	20.00	23.00
BUS 42	.985	.985	3.21	-59.00	30.69	-300.00	300.00	37.00	23.00
BUS 46	1.080	1.080	13.36	89.00	97.76	-100.00	100.00	28.00	10.00
BUS 49	1.025	1.025	15.53	204.00	26.55	-85.00	210.00	87.00	30.00
BUS 54	.970	.970	11.14	48.00	-18.38	-300.00	300.00	113.00	52.00
BUS 55	.970	.970	10.80	.00	3.53	-8.00	23.00	63.00	22.00
BUS 56	.970	.974+	11.20	.00	-7.19	-8.00	15.00	84.00	38.00
BUS 59	.985	.985	11.73	.00	78.63	-60.00	180.00	277.00	113.00
BUS 61	.995	.995	17.01	160.00	-8.87	-100.00	300.00	.00	.00
BUS 62	.998	.998	16.13	.00	21.60	-20.00	30.00	77.00	24.00
BUS 65	1.005	1.005	22.11	391.00	140.85	-67.00	200.00	.00	.00
BUS 66	1.050	1.050	20.57	392.00	33.03	-67.00	200.00	39.00	18.00
BUS 70	.984	.984+	22.62	.00	-4.43	-10.00	32.00	66.00	20.00
BUS 72	.980	.980	22.79	43.00	-22.46	-100.00	100.00	.00	.00
BUS 73	.991	.991	24.26	37.00	.52	-100.00	100.00	.00	.00
BUS 74	.975	.975	20.18	.00	30.64	-6.00	39.00	68.00	27.00
BUS 76	.970	.970	19.22	.00	40.95	-8.00	80.00	68.00	37.00
BUS 77	1.006	1.007+	23.71	.00	-20.00	-20.00	70.00	61.00	20.00
BUS 80	1.040	1.040	24.57	223.50	214.39	-165.00	280.00	130.00	56.00
BUS 85	1.020	1.020	28.50	.00	2.92	-8.00	23.00	24.00	15.00
BUS 87	1.015	1.015	27.74	4.00	-22.23	-100.00	1000.00	.00	.00
BUS 89	1.055	1.055	35.34	607.00	113.91	-210.00	300.00	.00	.00
BUS 90	.985	.985	28.91	-85.00	-13.67	-300.00	300.00	78.00	52.00
BUS 91	.985	.985	31.01	20.00	-44.65	-100.00	100.00	.00	.00
BUS 92	1.030	1.033+	31.70	.00	-2.68	-3.00	20.00	65.00	20.00
BUS 99	1.015	1.015	29.36	35.00	-24.39	-100.00	100.00	.00	.00
BUS 100	1.017	1.017	29.50	252.00	58.17	-50.00	155.00	37.00	18.00

BUS 103	1.000	1.000	27.97	40.00	31.40	-15.00	50.00	23.00	16.00
BUS 104	.971	.971	25.76	.00	6.57	-8.00	53.00	38.00	25.00
BUS 107	.980	.980	25.70	45.00	17.02	-200.00	200.00	28.00	12.00
BUS 111	.980	.980	28.32	36.00	4.66	-100.00	1000.00	.00	.00
BUS 112	.975	.975	27.93	55.00	11.36	-100.00	1000.00	25.00	13.00
BUS 116	1.005	1.005	23.25	-184.00	99.87	-1000.00	1000.00	.00	.00
A 1	1.050	1.050	10.91	100.00	6.36	-100.00	100.00	.00	.00
A 2	1.045	1.045-	8.46	80.00	80.00	-20.00	80.00	21.70	12.70
A 5	1.010	1.010	4.75	50.00	34.69	-15.00	62.45	94.20	39.00
A 8	1.000	.998-	2.68	20.00	85.00	-15.00	85.00	30.00	30.00
A 11	1.050	1.050	4.81	20.00	8.72	-10.00	45.83	.00	.00
A 13	1.050	1.050	3.23	20.00	4.91	-15.00	56.57	.00	.00
B 1	1.050	1.050	3.50	100.00	70.11	-100.00	100.00	.00	.00
B 2	1.045	1.045	2.97	80.00	42.18	-20.00	60.00	21.70	12.70
B 5	1.010	1.010	-.77	50.00	36.88	-15.00	62.45	94.20	39.00
B 8	1.010	1.010	1.87	20.00	64.88	-15.00	75.00	30.00	30.00
B 11	1.050	1.050	2.31	20.00	7.07	-10.00	45.83	.00	.00
B 13	1.050	1.050	.26	20.00	4.25	-15.00	56.57	.00	.00
C 1	1.050	1.050	32.42	100.00	24.35	-100.00	100.00	.00	.00
C 2	1.045	1.045	31.45	80.00	37.41	-20.00	60.00	21.70	12.70
C 5	1.010	1.010	27.89	50.00	14.94	-15.00	62.45	94.20	39.00
C 8	1.010	1.010	26.12	20.00	42.70	-15.00	75.00	30.00	30.00
C 11	1.050	1.050	27.54	20.00	6.75	-10.00	45.83	.00	.00
C 13	1.050	1.050	25.81	20.00	3.85	-15.00	56.57	.00	.00
D 1	1.025	1.021-	13.77	100.00	100.00	-100.00	100.00	.00	.00
D 2	1.020	1.020	15.05	80.00	9.93	-20.00	60.00	21.70	12.70
D 5	1.010	1.010	17.11	50.00	.46	-15.00	62.45	94.20	39.00
D 8	1.010	1.010	14.09	20.00	47.91	-15.00	75.00	30.00	30.00
D 11	1.050	1.050	14.14	20.00	8.38	-10.00	45.83	.00	.00
D 13	1.050	1.050	11.86	20.00	7.06	-15.00	56.57	.00	.00
E 1	1.060	1.060	31.47	250.00	83.81	-40.00	90.00	20.00	12.00
E 2	1.045	1.028-	27.12	40.00	50.00	-40.00	50.00	21.70	12.70
E 3	.970	.970	20.14	.00	31.92	.00	70.00	94.20	39.00
E 6	1.040	1.040	19.65	.00	15.97	-6.00	34.00	11.20	7.50
E 8	1.050	1.050	20.40	.00	15.85	-6.00	34.00	.00	.00

Bus	Voltage		Load	
BUS 2	.973	-2.49	20.00	9.00
BUS 3	.967	-2.49	50.00	20.00
BUS 5	1.000	1.80	40.00	18.00
BUS 7	.987	-1.52	51.00	14.00
BUS 9	1.040	10.02	.00	.00
BUS 11	.985	-.78	70.00	23.00
BUS 13	.968	-1.45	34.00	16.00
BUS 14	.981	-1.18	14.00	5.00
BUS 16	.983	-.63	25.00	10.00
BUS 17	.994	3.32	11.00	3.00
BUS 20	1.017	2.31	18.00	7.00
BUS 21	1.001	1.71	44.00	15.00
BUS 22	.993	3.40	45.00	13.00
BUS 23	.989	13.18	62.00	28.00
BUS 28	.960	6.05	17.00	7.00
BUS 29	.960	4.22	24.00	14.00
BUS 30	.984	7.97	.00	.00
BUS 33	.971	1.34	23.00	9.00
BUS 35	.980	2.84	33.00	19.00
BUS 37	.992	3.74	.00	.00
BUS 38	.961	8.41	.00	.00
BUS 39	.971	1.99	27.00	11.00
BUS 41	.967	1.48	37.00	10.00
BUS 43	.991	3.15	18.00	7.00
BUS 44	1.012	5.54	16.00	8.00
BUS 45	1.020	8.52	83.00	45.00
BUS 47	1.022	15.63	64.00	30.00
BUS 48	1.038	13.85	20.00	11.00
BUS 50	1.007	13.82	17.00	4.00
BUS 51	.985	12.05	17.00	8.00
BUS 52	.975	11.15	18.00	5.00
BUS 53	.962	10.24	23.00	11.00
BUS 57	.985	11.93	12.00	3.00
BUS 58	.978	11.41	12.00	3.00
BUS 60	.989	16.07	78.00	43.00
BUS 63	.967	15.79	.00	.00
BUS 64	.982	17.93	.00	.00
BUS 67	1.016	16.23	28.00	7.00
BUS 68	1.001	23.70	.00	.00
BUS 71	.987	23.28	.00	.00
BUS 75	.974	21.22	80.00	25.00
BUS 78	1.004	23.24	71.00	26.00
BUS 79	1.010	23.22	39.00	32.00
BUS 81	.993	24.05	.00	.00
BUS 82	1.003	25.14	54.00	27.00
BUS 83	1.008	25.92	20.00	10.00
BUS 84	1.012	27.45	11.00	7.00
BUS 86	1.022	27.23	21.00	10.00
BUS 88	1.026	31.60	48.00	25.00
BUS 93	1.015	29.55	12.00	7.00
BUS 94	1.008	28.08	30.00	16.00
BUS 95	1.000	26.88	42.00	31.00
BUS 96	1.006	25.84	38.00	15.00
BUS 97	1.021	25.69	15.00	9.00
BUS 98	.990	24.34	64.00	48.00
BUS 101	1.020	29.68	22.00	15.00

BUS 102	1.042	31.01	25.00	3.00
BUS 105	.965	25.28	31.00	34.00
BUS 106	.957	24.72	69.00	36.00
BUS 108	.957	24.97	2.00	1.00
BUS 109	.954	24.88	48.00	10.00
BUS 110	.968	26.76	39.00	25.10
BUS 113	.992	3.55	6.00	-6.40
BUS 114	.957	6.12	20.00	3.00
BUS 115	.957	6.23	35.00	10.00
BUS 117	.974	-2.86	20.00	8.00
BUS 118	.966	19.83	33.00	15.00
A 3	1.015	6.08	2.40	1.20
A 4	1.007	5.12	7.60	1.60
A 6	1.002	3.89	.00	.00
A 7	.997	3.61	22.80	10.90
A 9	1.033	2.61	.00	.00
A 10	1.031	.75	5.80	2.00
A 12	1.044	1.76	11.20	7.50
A 14	1.028	.82	6.20	1.60
A 15	1.025	.67	8.20	2.50
A 16	1.031	1.08	3.50	1.80
A 17	1.026	.67	9.00	5.80
A 18	1.015	-.01	3.20	.90
A 19	1.012	-.22	9.50	3.40
A 20	1.016	-.04	2.20	.70
A 21	1.019	.29	17.50	11.20
A 22	1.020	.30	.00	.00
A 23	1.016	.16	3.20	1.60
A 24	1.013	-.17	8.70	6.70
A 25	1.021	-.11	.00	.00
A 26	1.005	-.59	3.50	2.30
A 27	1.034	.20	.00	.00
A 28	.992	3.25	.00	.00
A 29	1.022	-.40	2.40	.90
A 30	1.017	-.67	7.40	2.70
B 3	1.017	1.87	2.40	1.20
B 4	1.010	1.61	7.60	1.60
B 6	1.008	1.50	.00	.00
B 7	1.001	.06	22.80	10.90
B 9	1.037	.12	.00	.00
B 10	1.034	-1.78	5.80	2.00
B 12	1.045	-1.20	11.20	7.50
B 14	1.030	-2.06	6.20	1.60
B 15	1.027	-2.16	8.20	2.50
B 16	1.033	-1.70	3.50	1.80
B 17	1.029	-1.93	9.00	5.80
B 18	1.017	-2.73	3.20	.90
B 19	1.015	-2.88	9.50	3.40
B 20	1.019	-2.66	2.20	.70
B 21	1.023	-2.22	17.50	11.20
B 22	1.024	-2.20	.00	.00
B 23	1.019	-2.47	3.20	1.60
B 24	1.017	-2.54	8.70	6.70
B 25	1.026	-1.96	.00	.00
B 26	1.010	-2.43	3.50	2.30
B 27	1.040	-1.33	.00	.00
B 28	.995	2.19	.00	.00
B 29	1.028	-1.92	2.40	.90
B 30	1.023	-2.19	7.40	2.70
B 3	1.016	28.32	2.40	1.20

C 4	1.008	27.51	7.60	1.60
C 6	1.009	26.71	.00	.00
C 7	1.001	26.56	22.80	10.90
C 9	1.037	25.35	.00	.00
C 10	1.035	23.46	5.80	2.00
C 12	1.045	24.35	11.20	7.50
C 14	1.030	23.42	6.20	1.60
C 15	1.027	23.27	8.20	2.50
C 16	1.034	23.71	3.50	1.80
C 17	1.030	23.36	9.00	5.80
C 18	1.018	22.63	3.20	.90
C 19	1.015	22.44	9.50	3.40
C 20	1.019	22.64	2.20	.70
C 21	1.024	22.98	17.50	11.20
C 22	1.025	22.99	.00	.00
C 23	1.020	22.78	3.20	1.60
C 24	1.018	22.47	8.70	6.70
C 25	1.029	22.45	.00	.00
C 26	1.013	21.98	3.50	2.30
C 27	1.044	22.71	.00	.00
C 28	1.003	25.70	.00	.00
C 29	1.031	22.12	2.40	.90
C 30	1.026	21.85	7.40	2.70
D 3	1.003	13.18	2.40	1.20
D 4	1.000	13.13	7.60	1.60
D 6	1.003	13.48	.00	.00
D 7	.997	14.24	22.80	10.90
D 9	1.034	11.94	.00	.00
D 10	1.032	9.95	5.80	2.00
D 12	1.041	10.39	11.20	7.50
D 14	1.026	9.53	6.20	1.60
D 15	1.023	9.44	8.20	2.50
D 16	1.030	9.94	3.50	1.80
D 17	1.026	9.78	9.00	5.80
D 18	1.014	8.90	3.20	.90
D 19	1.012	8.78	9.50	3.40
D 20	1.016	9.02	2.20	.70
D 21	1.020	9.48	17.50	11.20
D 22	1.021	9.48	.00	.00
D 23	1.016	9.09	3.20	1.60
D 24	1.014	8.99	8.70	6.70
D 25	1.024	9.27	.00	.00
D 26	1.009	8.79	3.50	2.30
D 27	1.039	9.71	.00	.00
D 28	.997	12.98	.00	.00
D 29	1.027	9.11	2.40	.90
D 30	1.022	8.84	7.40	2.70
E 4	.982	23.55	47.80	20.00
E 5	.990	25.65	7.60	1.60
E 7	1.023	20.40	.00	.00
E 9	1.018	18.76	29.50	16.60
E 10	1.014	18.62	9.00	5.80
E 11	1.023	19.00	3.50	1.80
E 12	1.024	18.73	6.10	1.60
E 13	1.019	18.64	13.50	5.80
E 14	1.000	17.64	14.90	5.00

Power Generated:	5644.87	2067.11
Power Demanded:	5468.80	2575.10
System Losses:	176.07	-507.99

Appendix K

250 Bus Network

Contingency AII

K.1 Bus Oriented Results

```
    Time for input:  2.97
    Time for compact:   .24
    Time for factorization:   .29
No. of iterations:  4.5
Maximum mismatch (in pu):  1.1E-04 1.2E-04
    Time for solution:   :20
Execution time:  3.70

S base : 100.
```

Bus	Vsp	Voltage		Generation		QGmin	QGmax	Load	
BUS 69		1.035	30.00	204.12	-40.26				
BUS 1	..960	.960	20.61	.00	12.90	-5.00	35.00	51.00	27.00
BUS 4	.998	.998	26.25	50.00	-12.96	-300.00	300.00	30.00	12.00
BUS 6	.990	.990	23.06	.00	31.74	-13.00	50.00	52.00	22.00
BUS 8	1.015	1.015	32.13	40.00	156.91	-300.00	300.00	.00	10.00
BUS 10	1.055	1.055	47.03	450.00	34.26	-147.00	200.00	.00	.00
BUS 12	.990	.990	22.23	85.00	113.04	-35.00	120.00	47.00	20.00
BUS 15	.970	.970	20.30	.00	-2.74	-10.00	50.00	90.00	40.00
BUS 18	.973	.973	20.54	.00	10.72	-16.00	50.00	60.00	34.00
BUS 19	.960	.972+	19.50	.00	-4.81	-8.00	24.00	45.00	25.00
BUS 24	.992	.992	23.08	49.00	31.29	-300.00	300.00	.00	.00
BUS 25	1.050	1.050	45.47	220.00	23.05	-47.00	140.00	.00	.00
BUS 26	1.015	1.015	45.29	314.00	29.37	-1000.00	1000.00	.00	.00
BUS 27	.968	.968	26.59	45.00	12.54	-300.00	300.00	20.00	13.00
BUS 31	.967	.967	21.49	7.00	40.98	-300.00	300.00	43.00	27.00
BUS 32	.963	.964+	21.91	.00	5.59	-14.00	42.00	59.00	23.00
BUS 34	.984	.987+	19.13	.00	-5.20	-8.00	24.00	59.00	26.00
BUS 36	.980	.980	18.75	.00	1.05	-8.00	24.00	31.00	17.00
BUS 40	.970	.970	15.33	-46.00	-34.21	-300.00	300.00	20.00	23.00
BUS 42	.985	.985	15.42	-59.00	26.48	-300.00	300.00	37.00	23.00
BUS 46	1.080	1.080	23.24	89.00	91.09	-100.00	100.00	28.00	10.00
BUS 49	1.025	1.025	25.30	204.00	-.78	-85.00	210.00	87.00	30.00
BUS 54	.970	.970	22.37	48.00	-19.92	-300.00	300.00	113.00	52.00
BUS 55	.970	.970	22.15	.00	2.91	-8.00	23.00	63.00	22.00
BUS 56	.970	.974+	22.47	.00	-8.00	-8.00	15.00	84.00	38.00
BUS 59	.985	.985	24.49	155.00	42.53	-60.00	180.00	277.00	113.00
BUS 61	.995	.995	27.93	160.00	-13.96	-100.00	300.00	.00	.00
BUS 62	.998	.998	26.90	.00	20.71	-20.00	30.00	77.00	24.00
BUS 65	1.005	1.005	31.03	391.00	101.83	-67.00	200.00	.00	.00
BUS 66	1.050	1.050	30.22	392.00	38.79	-67.00	200.00	39.00	18.00
BUS 70	.984	.984+	25.46	.00	-9.31	-10.00	32.00	66.00	20.00
BUS 72	.980	.980	27.47	43.00	-23.64	-100.00	100.00	.00	.00
BUS 73	.991	.991	27.40	37.00	.62	-100.00	100.00	.00	.00
BUS 74	.975	.975	23.38	.00	28.08	-6.00	39.00	68.00	27.00
BUS 76	.970	.970	24.03	.00	42.28	-8.00	80.00	68.00	37.00
BUS 77	1.006	1.006+	30.67	.00	-18.31	-20.00	70.00	61.00	20.00
BUS 80	1.040	1.040	33.75	477.00	172.82	-165.00	280.00	130.00	56.00
BUS 85	1.020	1.020	36.82	.00	3.03	-8.00	23.00	24.00	15.00
BUS 87	1.015	1.015	36.06	4.00	-22.23	-100.00	1000.00	.00	.00
BUS 89	1.055	1.055	43.79	607.00	114.17	-210.00	300.00	.00	.00
BUS 90	.985	.985	37.42	-85.00	-13.92	-300.00	300.00	78.00	52.00
BUS 91	.985	.985	39.51	20.00	-44.66	-100.00	100.00	.00	.00
BUS 92	1.030	1.033+	40.19	.00	-3.00	-3.00	20.00	65.00	20.00
BUS 99	1.015	1.015	38.18	35.00	-24.66	-100.00	100.00	.00	.00
BUS 100	1.017	1.017	38.18	252.00	57.43	-50.00	155.00	37.00	18.00

BUS 103	1.000	1.000	36.65	40.00	31.40	-15.00	50.00	23.00	16.00
BUS 104	.971	.971	34.44	.00	6.57	-8.00	53.00	38.00	25.00
BUS 107	.980	.980	34.38	45.00	17.02	-200.00	200.00	28.00	12.00
BUS 111	.980	.980	37.00	36.00	4.66	-100.00	1000.00	.00	.00
BUS 112	.975	.975	36.61	55.00	11.36	-100.00	1000.00	25.00	13.00
BUS 116	1.005	1.005	29.81	-184.00	105.64	-1000.00	1000.00	.00	.00
A 1	1.050	1.050	22.22	100.00	3.91	-100.00	100.00	.00	.00
A 2	1.045	1.045	19.98	80.00	77.13	-20.00	80.00	21.70	12.70
A 5	1.010	1.010	16.65	50.00	32.32	-15.00	62.45	94.20	39.00
A 8	1.000	.998-	15.47	20.00	84.74	-15.00	85.00	30.00	30.00
A 11	1.050	1.050	17.06	20.00	8.46	-10.00	45.83	.00	.00
A 13	1.050	1.050	15.36	20.00	4.70	-15.00	56.57	.00	.00
B 1	1.050	1.050	18.53	100.00	70.24	-100.00	100.00	.00	.00
B 2	1.045	1.045	17.64	80.00	43.46	-20.00	60.00	21.70	12.70
B 5	1.010	1.010	13.66	50.00	36.91	-15.00	62.45	94.20	39.00
B 8	1.010	1.010	15.53	20.00	68.46	-15.00	75.00	30.00	30.00
B 11	1.050	1.050	16.50	20.00	7.20	-10.00	45.83	.00	.00
B 13	1.050	1.050	14.52	20.00	4.37	-15.00	56.57	.00	.00
C 1	1.050	1.050	40.85	100.00	24.36	-100.00	100.00	.00	.00
C 2	1.045	1.045	39.83	80.00	37.74	-20.00	60.00	21.70	12.70
C 5	1.010	1.010	36.21	50.00	14.98	-15.00	62.45	94.20	39.00
C 8	1.010	1.010	34.33	20.00	43.12	-15.00	75.00	30.00	30.00
C 11	1.050	1.050	35.81	20.00	6.78	-10.00	45.83	.00	.00
C 13	1.050	1.050	34.12	20.00	3.82	-15.00	56.57	.00	.00
D 1	1.025	1.021-	24.83	100.00	99.99	-100.00	100.00	.00	.00
D 2	1.020	1.020	25.90	80.00	9.61	-20.00	60.00	21.70	12.70
D 5	1.010	1.010	27.25	50.00	-1.22	-15.00	62.45	94.20	39.00
D 8	1.010	1.010	24.82	20.00	46.69	-15.00	75.00	30.00	30.00
D 11	1.050	1.050	24.99	20.00	8.35	-10.00	45.83	.00	.00
D 13	1.050	1.050	22.71	20.00	7.02	-15.00	56.57	.00	.00
E 1	1.060	1.060	40.07	250.00	83.58	-40.00	90.00	20.00	12.00
E 2	1.045	1.028-	35.76	40.00	49.98	-40.00	50.00	21.70	12.70
E 3	.970	.970	28.76	.00	31.82	.00	70.00	94.20	39.00
E 6	1.040	1.040	28.23	.00	15.95	-6.00	34.00	11.20	7.50
E 8	1.050	1.050	28.98	.00	15.83	-6.00	34.00	.00	.00

Bus	Voltage		Load	
BUS 2	.973	21.21	20.00	9.00
BUS 3	.967	21.59	50.00	20.00
BUS 5	1.001	26.50	40.00	18.00
BUS 7	.987	22.39	51.00	14.00
BUS 9	1.034	39.49	.00	.00
BUS 11	.985	23.01	70.00	23.00
BUS 13	.968	21.36	34.00	16.00
BUS 14	.981	21.31	14.00	5.00
BUS 16	.984	21.76	25.00	10.00
BUS 17	.994	23.21	11.00	3.00
BUS 20	1.017	17.79	18.00	7.00
BUS 21	1.000	15.88	44.00	15.00
BUS 22	.991	15.88	45.00	13.00
BUS 23	.971	20.55	62.00	28.00
BUS 28	.960	23.89	17.00	7.00
BUS 29	.960	21.82	24.00	14.00
BUS 30	.980	29.32	.00	.00
BUS 33	.972	19.14	23.00	9.00
BUS 35	.980	18.76	33.00	19.00
BUS 37	.993	19.66	.00	.00
BUS 38	.962	24.84	.00	.00
BUS 39	.971	16.37	27.00	11.00
BUS 41	.967	14.61	37.00	10.00
BUS 43	.991	17.42	18.00	7.00
BUS 44	1.013	17.43	16.00	8.00
BUS 45	1.022	19.56	83.00	45.00
BUS 47	1.026	24.18	64.00	30.00
BUS 48	1.039	23.92	20.00	11.00
BUS 50	1.007	23.94	17.00	4.00
BUS 51	.986	22.70	17.00	8.00
BUS 52	.975	21.89	18.00	5.00
BUS 53	.962	21.27	23.00	11.00
BUS 57	.985	22.70	12.00	3.00
BUS 58	.979	22.32	12.00	3.00
BUS 60	.989	27.10	78.00	43.00
BUS 63	.970	27.10	.00	.00
BUS 64	.984	28.45	.00	.00
BUS 67	1.016	26.63	28.00	7.00
BUS 68	1.001	30.26	.00	.00
BUS 71	.987	26.42	.00	.00
BUS 75	.975	24.51	80.00	25.00
BUS 78	1.004	30.47	71.00	26.00
BUS 79	1.009	30.96	39.00	32.00
BUS 81	.993	31.61	.00	.00
BUS 82	1.003	33.21	54.00	27.00
BUS 83	1.008	34.09	20.00	10.00
BUS 84	1.012	35.71	11.00	7.00
BUS 86	1.022	35.54	21.00	10.00
BUS 88	1.026	40.00	48.00	25.00
BUS 93	1.015	38.07	12.00	7.00
BUS 94	1.008	36.61	30.00	16.00
BUS 95	1.000	35.35	42.00	31.00
BUS 96	1.006	34.32	38.00	15.00
BUS 97	1.021	34.44	15.00	9.00
BUS 98	.990	33.34	64.00	48.00
BUS 101	1.020	38.30	22.00	15.00

BUS 102	1.042	39.57	25.00	3.00
BUS 105	.965	33.96	31.00	34.00
BUS 106	.957	33.40	69.00	36.00
BUS 108	.957	33.65	2.00	1.00
BUS 109	.954	33.56	48.00	10.00
BUS 110	.968	35.44	39.00	25.10
BUS 113	.992	22.92	6.00	-6.40
BUS 114	.957	22.81	20.00	3.00
BUS 115	.956	23.09	35.00	10.00
BUS 117	.974	20.69	20.00	8.00
BUS 118	.966	23.84	33.00	15.00
A 3	1.016	17.99	2.40	1.20
A 4	1.008	17.15	7.60	1.60
A 6	1.003	16.18	.00	.00
A 7	.998	15.76	22.80	10.90
A 9	1.034	14.86	.00	.00
A 10	1.031	12.99	5.80	2.00
A 12	1.044	13.90	11.20	7.50
A 14	1.029	12.98	6.20	1.60
A 15	1.025	12.83	8.20	2.50
A 16	1.032	13.25	3.50	1.80
A 17	1.026	12.88	9.00	5.80
A 18	1.015	12.17	3.20	.90
A 19	1.012	11.98	9.50	3.40
A 20	1.016	12.17	2.20	.70
A 21	1.020	12.52	17.50	11.20
A 22	1.021	12.53	.00	.00
A 23	1.017	12.35	3.20	1.60
A 24	1.013	12.06	8.70	6.70
A 25	1.021	12.16	.00	.00
A 26	1.006	11.68	3.50	2.30
A 27	1.035	12.49	.00	.00
A 28	.992	15.57	.00	.00
A 29	1.023	11.89	2.40	.90
A 30	1.017	11.62	7.40	2.70
B 3	1.017	16.31	2.40	1.20
B 4	1.009	15.92	7.60	1.60
B 6	1.008	15.65	.00	.00
B 7	1.001	14.31	22.80	10.90
B 9	1.036	14.31	.00	.00
B 10	1.034	12.43	5.80	2.00
B 12	1.045	13.06	11.20	7.50
B 14	1.029	12.19	6.20	1.60
B 15	1.027	12.10	8.20	2.50
B 16	1.033	12.53	3.50	1.80
B 17	1.029	12.28	9.00	5.80
B 18	1.017	11.50	3.20	.90
B 19	1.014	11.34	9.50	3.40
B 20	1.018	11.56	2.20	.70
B 21	1.022	12.00	17.50	11.20
B 22	1.023	12.02	.00	.00
B 23	1.018	11.78	3.20	1.60
B 24	1.016	11.70	8.70	6.70
B 25	1.026	12.34	.00	.00
B 26	1.010	11.86	3.50	2.30
B 27	1.040	12.99	.00	.00
B 28	.994	16.55	.00	.00
B 29	1.028	12.40	2.40	.90
B 30	1.023	12.13	7.40	2.70
C 3	1.016	36.68	2.40	1.20

C 4	1.008	35.87	7.60	1.60
C 6	1.009	34.98	.00	.00
C 7	1.001	34.84	22.80	10.90
C 9	1.037	33.63	.00	.00
C 10	1.035	31.74	5.80	2.00
C 12	1.045	32.66	11.20	7.50
C 14	1.030	31.73	6.20	1.60
C 15	1.027	31.58	8.20	2.50
C 16	1.034	32.01	3.50	1.80
C 17	1.030	31.64	9.00	5.80
C 18	1.018	30.92	3.20	.90
C 19	1.015	30.73	9.50	3.40
C 20	1.019	30.93	2.20	.70
C 21	1.024	31.26	17.50	11.20
C 22	1.025	31.27	.00	.00
C 23	1.020	31.07	3.20	1.60
C 24	1.018	30.74	8.70	6.70
C 25	1.028	30.68	.00	.00
C 26	1.013	30.20	3.50	2.30
C 27	1.043	30.91	.00	.00
C 28	1.003	33.86	.00	.00
C 29	1.031	30.32	2.40	.90
C 30	1.026	30.05	7.40	2.70
D 3	1.004	24.05	2.40	1.20
D 4	1.000	23.96	7.60	1.60
D 6	1.003	24.31	.00	.00
D 7	.998	24.81	22.80	10.90
D 9	1.034	22.79	.00	.00
D 10	1.032	20.81	5.80	2.00
D 12	1.041	21.24	11.20	7.50
D 14	1.026	20.39	6.20	1.60
D 15	1.023	20.30	8.20	2.50
D 16	1.030	20.80	3.50	1.80
D 17	1.026	20.64	9.00	5.80
D 18	1.014	19.77	3.20	.90
D 19	1.012	19.65	9.50	3.40
D 20	1.016	19.88	2.20	.70
D 21	1.020	20.35	17.50	11.20
D 22	1.021	20.36	.00	.00
D 23	1.016	19.98	3.20	1.60
D 24	1.014	19.90	8.70	6.70
) 25	1.025	20.27	.00	.00
) 26	1.009	19.79	3.50	2.30
) 27	1.040	20.76	.00	.00
) 28	.997	24.12	.00	.00
) 29	1.028	20.17	2.40	.90
) 30	1.022	19.90	7.40	2.70
: 4	.982	32.14	47.80	20.00
: 5	.990	34.23	7.60	1.60
: 7	1.023	28.98	.00	.00
: 9	1.018	27.35	29.50	16.60
: 10	1.014	27.20	9.00	5.80
: 11	1.023	27.58	3.50	1.80
: 12	1.024	27.31	6.10	1.60
: 13	1.019	27.23	13.50	5.80
: 14	1.000	26.22	14.90	5.00

ower Generated:	5630.12	2060.61
'ower Demanded:	5468.80	2575.10
ystem Losses:	161.32	-514.49

Appendix L

250 Bus Network

Contingency AIII

L.1. Bus Oriended Results

Time for input: 3.16
Time for compact: .24
Time for factorization: .29
No. of iterations: 7
Maximum mismatch (in pu): 3.2E-04 4.9E-04
Time for solution: .28
Execution time: 3.98

S base : 100.

Bus	Vsp	Voltage		Generation		QGmin	QGmax	Load	
BUS 69		1.035	30.00	202.61	-36.71				
BUS 1	.960	.960	18.29	.00	12.92	-5.00	35.00	51.00	27.00
BUS 4	.998	.998	23.82	50.00	-12.39	-300.00	300.00	30.00	12.00
BUS 6	.990	.990	20.71	.00	31.66	-13.00	50.00	52.00	22.00
BUS 8	1.015	1.015	29.52	40.00	144.85	-300.00	300.00	.00	10.00
BUS 10	1.055	1.055	44.43	450.00	34.26	-147.00	200.00	.00	.00
BUS 12	.990	.990	19.97	85.00	112.26	-35.00	120.00	47.00	20.00
BUS 15	.970	.970	18.77	.00	-5.46	-10.00	50.00	90.00	40.00
BUS 18	.973	.973	19.10	.00	8.47	-16.00	50.00	60.00	34.00
BUS 19	.960	.972+	18.43	.00	-8.00	-8.00	24.00	45.00	25.00
BUS 24	.992	.992	29.67	49.00	-10.32	-300.00	300.00	.00	.00
BUS 25	1.050	1.050	35.72	220.00	70.80	-47.00	140.00	.00	.00
BUS 26	1.015	1.015	37.45	314.00	10.31	-1000.00	1000.00	.00	.00
BUS 27	.968	.968	25.02	45.00	-9.98	-300.00	300.00	20.00	13.00
BUS 31	.967	.967	20.93	7.00	40.49	-300.00	300.00	43.00	27.00
BUS 32	.963	.964+	22.65	.00	-13.99	-14.00	42.00	59.00	23.00
BUS 34	.984	.987+	17.60	.00	-8.00	-8.00	24.00	59.00	26.00
BUS 36	.980	.980	17.21	.00	.68	-8.00	24.00	31.00	17.00
BUS 40	.970	.970	14.13	-46.00	-35.26	-300.00	300.00	20.00	23.00
BUS 42	.985	.985	14.40	-59.00	26.93	-300.00	300.00	37.00	23.00
BUS 46	1.080	1.080	22.51	89.00	91.59	-100.00	100.00	28.00	10.00
BUS 49	1.025	1.025	24.63	204.00	1.01	-85.00	210.00	87.00	30.00
BUS 54	.970	.970	21.73	48.00	-19.94	-300.00	300.00	113.00	52.00
BUS 55	.970	.970	21.51	.00	2.91	-8.00	23.00	63.00	22.00
BUS 56	.970	.974+	21.83	.00	-8.00	-8.00	15.00	84.00	38.00
BUS 59	.985	.985	23.87	155.00	42.51	-60.00	180.00	277.00	113.00
BUS 61	.995	.995	27.32	160.00	-13.97	-100.00	300.00	.00	.00
BUS 62	.998	.998	26.28	.00	20.71	-20.00	30.00	77.00	24.00
BUS 65	1.005	1.005	30.43	391.00	101.61	-67.00	200.00	.00	.00
BUS 66	1.050	1.050	29.59	392.00	38.64	-67.00	200.00	39.00	18.00
BUS 70	.984	.984+	27.04	.00	-10.00	-10.00	32.00	66.00	20.00
BUS 72	.980	.980	31.67	43.00	-23.87	-100.00	100.00	.00	.00
BUS 73	.991	.991	29.40	37.00	1.09	-100.00	100.00	.00	.00
BUS 74	.975	.975	24.26	.00	27.62	-6.00	39.00	68.00	27.00
BUS 76	.970	.970	24.41	.00	41.49	-8.00	80.00	68.00	37.00
BUS 77	1.006	1.006+	30.62	.00	-19.15	-20.00	70.00	61.00	20.00
BUS 80	1.040	1.040	33.45	477.00	173.84	-165.00	280.00	130.00	56.00
BUS 85	1.020	1.020	39.33	.00	6.14	-8.00	23.00	24.00	15.00
BUS 87	1.015	1.015	38.58	4.00	-22.23	-100.00	1000.00	.00	.00
BUS 89	1.055	1.055	48.99	607.00	71.43	-210.00	300.00	.00	.00
BUS 90	.985	.985	39.66	-85.00	-3.94	-300.00	300.00	78.00	52.00
BUS 91	.985	.985	39.57	20.00	-36.89	-100.00	100.00	.00	.00
BUS 92	1.030	1.022-	37.24	.00	20.00	-3.00	20.00	65.00	20.00
BUS 99	1.015	1.015	37.14	35.00	-25.11	-100.00	100.00	.00	.00
BUS 100	1.017	1.017	36.84	252.00	66.12	-50.00	155.00	37.00	18.00

BUS 103	1.000	1.000	35.31	40.00	31.40	-15.00	50.00	23.00	16.00
BUS 104	.971	.971	33.10	.00	6.57	-8.00	53.00	38.00	25.00
BUS 107	.980	.980	33.04	45.00	17.02	-200.00	200.00	28.00	12.00
BUS 111	.980	.980	35.66	36.00	4.66	-100.00	1000.00	.00	.00
BUS 112	.975	.975	35.27	55.00	11.36	-100.00	1000.00	25.00	13.00
BUS 116	1.005	1.005	29.42	-184.00	104.24	-1000.00	1000.00	.00	.00
A 1	1.050	1.050	21.32	100.00	4.11	-100.00	100.00	.00	.00
A 2	1.045	1.045	19.05	80.00	77.67	-20.00	80.00	21.70	12.70
A 5	1.010	1.010	15.67	50.00	32.51	-15.00	62.45	94.20	39.00
A 8	1.000	.998-	14.36	20.00	85.00	-15.00	85.00	30.00	30.00
A 11	1.050	1.050	16.03	20.00	8.48	-10.00	45.83	.00	.00
A 13	1.050	1.050	14.35	20.00	4.71	-15.00	56.57	.00	.00
B 1	1.050	1.050	20.11	100.00	69.35	-100.00	100.00	.00	.00
B 2	1.045	1.045	19.48	80.00	42.28	-20.00	60.00	21.70	12.70
B 5	1.010	1.010	15.68	50.00	36.83	-15.00	62.45	94.20	39.00
B 8	1.010	1.010	18.15	20.00	63.10	-15.00	75.00	30.00	30.00
B 11	1.050	1.050	18.69	20.00	7.06	-10.00	45.83	.00	.00
B 13	1.050	1.050	16.67	20.00	4.20	-15.00	56.57	.00	.00
C 1	1.050	1.050	39.97	100.00	42.95	-100.00	100.00	.00	.00
C 2	1.045	1.045	40.53	80.00	39.76	-20.00	60.00	21.70	12.70
C 5	1.010	1.010	38.11	50.00	16.04	-15.00	62.45	94.20	39.00
C 8	1.010	1.010	34.92	20.00	46.25	-15.00	75.00	30.00	30.00
C 11	1.050	1.050	36.18	20.00	6.85	-10.00	45.83	.00	.00
C 13	1.050	1.050	34.29	20.00	4.15	-15.00	56.57	.00	.00
D 1	1.025	1.021-	24.19	100.00	100.00	-100.00	100.00	.00	.00
D 2	1.020	1.020	25.26	80.00	9.60	-20.00	60.00	21.70	12.70
D 5	1.010	1.010	26.62	50.00	-1.21	-15.00	62.45	94.20	39.00
D 8	1.010	1.010	24.19	20.00	46.69	-15.00	75.00	30.00	30.00
D 11	1.050	1.050	24.35	20.00	8.35	-10.00	45.83	.00	.00
D 13	1.050	1.050	22.08	20.00	7.02	-15.00	56.57	.00	.00
E 1	1.060	1.059-	38.99	250.00	90.00	-40.00	90.00	20.00	12.00
E 2	1.045	1.028-	35.37	40.00	49.96	-40.00	50.00	21.70	12.70
E 3	.970	.970	28.75	.00	32.34	.00	70.00	94.20	39.00
E 6	1.040	1.040	28.78	.00	16.23	-6.00	34.00	11.20	7.50
E 8	1.050	1.050	29.40	.00	15.99	-6.00	34.00	.00	.00

Bus	Voltage		Load	
BUS 2	.973	18.93	20.00	9.00
BUS 3	.967	19.25	50.00	20.00
BUS 5	1.001	24.06	40.00	18.00
BUS 7	.987	20.07	51.00	14.00
BUS 9	1.034	36.88	.00	.00
BUS 11	.985	20.71	70.00	23.00
BUS 13	.968	19.24	34.00	16.00
BUS 14	.981	19.24	14.00	5.00
BUS 16	.984	19.64	25.00	10.00
BUS 17	.995	21.38	11.00	3.00
BUS 20	1.017	19.03	18.00	7.00
BUS 21	1.002	18.12	44.00	15.00
BUS 22	.995	19.43	45.00	13.00
BUS 23	.991	28.06	62.00	28.00
BUS 28	.960	22.73	17.00	7.00
BUS 29	.960	21.10	24.00	14.00
BUS 30	.985	26.38	.00	.00
BUS 33	.972	17.60	23.00	9.00
BUS 35	.980	17.22	33.00	19.00
BUS 37	.993	18.10	.00	.00
BUS 38	.964	23.02	.00	.00
BUS 39	.971	15.03	27.00	11.00
BUS 41	.967	13.46	37.00	10.00
BUS 43	.991	16.11	18.00	7.00
BUS 44	1.013	16.45	16.00	8.00
BUS 45	1.022	18.69	83.00	45.00
BUS 47	1.026	23.58	64.00	30.00
BUS 48	1.039	23.20	20.00	11.00
BUS 50	1.007	23.28	17.00	4.00
BUS 51	.986	22.05	17.00	8.00
BUS 52	.975	21.25	18.00	5.00
BUS 53	.962	20.62	23.00	11.00
BUS 57	.985	22.05	12.00	3.00
BUS 58	.979	21.67	12.00	3.00
BUS 60	.989	26.48	78.00	43.00
BUS 63	.970	26.49	.00	.00
BUS 64	.984	27.84	.00	.00
BUS 67	1.016	26.00	28.00	7.00
BUS 68	1.001	29.87	.00	.00
BUS 71	.987	28.42	.00	.00
BUS 75	.975	25.17	80.00	25.00
BUS 78	1.004	30.39	71.00	26.00
BUS 79	1.009	30.83	39.00	32.00
BUS 81	.993	31.25	.00	.00
BUS 82	1.003	33.49	54.00	27.00
BUS 83	1.007	34.92	20.00	10.00
BUS 84	1.011	37.68	11.00	7.00
BUS 86	1.022	38.06	21.00	10.00
BUS 88	1.024	44.12	48.00	25.00
BUS 93	1.010	36.01	12.00	7.00
BUS 94	1.005	35.37	30.00	16.00
BUS 95	.999	34.73	42.00	31.00
BUS 96	1.005	33.92	38.00	15.00
BUS 97	1.021	34.08	15.00	9.00
BUS 98	.991	32.66	64.00	48.00
BUS 101	1.018	36.70	22.00	15.00

BUS 102	1.037	37.76	25.00	3.00
BUS 105	.965	32.62	31.00	34.00
BUS 106	.957	32.06	69.00	36.00
BUS 108	.957	32.31	2.00	1.00
BUS 109	.954	32.22	48.00	10.00
BUS 110	.968	34.10	39.00	25.10
BUS 113	.993	21.41	6.00	-6.40
BUS 114	.957	22.58	20.00	3.00
BUS 115	.957	22.69	35.00	10.00
BUS 117	.974	18.43	20.00	8.00
BUS 118	.966	24.36	33.00	15.00
A 3	1.016	17.00	2.40	1.20
A 4	1.008	16.15	7.60	1.60
A 6	1.003	15.15	.00	.00
A 7	.998	14.74	22.80	10.90
A 9	1.034	13.83	.00	.00
A 10	1.031	11.96	5.80	2.00
A 12	1.044	12.89	11.20	7.50
A 14	1.029	11.96	6.20	1.60
A 15	1.025	11.81	8.20	2.50
A 16	1.032	12.23	3.50	1.80
A 17	1.026	11.86	9.00	5.80
A 18	1.015	11.15	3.20	.90
A 19	1.012	10.95	9.50	3.40
A 20	1.016	11.15	2.20	.70
A 21	1.020	11.49	17.50	11.20
A 22	1.021	11.50	.00	.00
A 23	1.017	11.33	3.20	1.60
A 24	1.013	11.03	8.70	6.70
A 25	1.021	11.13	.00	.00
A 26	1.005	10.65	3.50	2.30
A 27	1.035	11.46	.00	.00
A 28	.992	14.53	.00	.00
A 29	1.022	10.85	2.40	.90
A 30	1.017	10.58	7.40	2.70
B 3	1.017	18.33	2.40	1.20
B 4	1.010	18.04	7.60	1.60
B 6	1.008	17.88	.00	.00
B 7	1.001	16.46	22.80	10.90
B 9	1.037	16.50	.00	.00
B 10	1.034	14.61	5.80	2.00
B 12	1.045	15.20	11.20	7.50
B 14	1.030	14.34	6.20	1.60
B 15	1.027	14.24	8.20	2.50
B 16	1.033	14.69	3.50	1.80
B 17	1.029	14.46	9.00	5.80
B 18	1.017	13.66	3.20	.90
B 19	1.015	13.51	9.50	3.40
B 20	1.019	13.73	2.20	.70
B 21	1.023	14.17	17.50	11.20
B 22	1.024	14.19	.00	.00
B 23	1.019	13.92	3.20	1.60
B 24	1.017	13.85	8.70	6.70
B 25	1.026	14.43	.00	.00
B 26	1.010	13.95	3.50	2.30
B 27	1.040	15.05	.00	.00
B 28	.995	18.56	.00	.00
B 29	1.028	14.45	2.40	.90
B 30	1.023	14.19	7.40	2.70
C 3	1.016	36.54	2.40	1.20

C 4	1.008	35.89	7.60	1.60
C 6	1.008	35.41	.00	.00
C 7	1.001	35.82	22.80	10.90
C 9	1.037	33.99	.00	.00
C 10	1.035	32.06	5.80	2.00
C 12	1.045	32.83	11.20	7.50
C 14	1.030	31.92	6.20	1.60
C 15	1.027	31.79	8.20	2.50
C 16	1.034	32.25	3.50	1.80
C 17	1.030	31.94	9.00	5.80
C 18	1.018	31.17	3.20	.90
C 19	1.015	31.01	9.50	3.40
C 20	1.019	31.21	2.20	.70
C 21	1.024	31.58	17.50	11.20
C 22	1.025	31.58	.00	.00
C 23	1.019	31.31	3.20	1.60
C 24	1.018	31.04	8.70	6.70
C 25	1.028	31.01	.00	.00
C 26	1.012	30.53	3.50	2.30
C 27	1.043	31.26	.00	.00
C 28	1.003	34.23	.00	.00
C 29	1.031	30.66	2.40	.90
C 30	1.026	30.40	7.40	2.70
D 3	1.004	23.41	2.40	1.20
D 4	1.000	23.32	7.60	1.60
D 6	1.003	23.68	.00	.00
D 7	.998	24.18	22.80	10.90
D 9	1.034	22.16	.00	.00
D 10	1.032	20.18	5.80	2.00
D 12	1.041	20.61	11.20	7.50
D 14	1.026	19.75	6.20	1.60
D 15	1.023	19.66	8.20	2.50
D 16	1.030	20.17	3.50	1.80
D 17	1.026	20.00	9.00	5.80
D 18	1.014	19.13	3.20	.90
D 19	1.012	19.01	9.50	3.40
D 20	1.016	19.24	2.20	.70
D 21	1.020	19.71	17.50	11.20
D 22	1.021	19.72	.00	.00
D 23	1.016	19.34	3.20	1.60
D 24	1.014	19.26	8.70	6.70
D 25	1.025	19.63	.00	.00
D 26	1.009	19.16	3.50	2.30
D 27	1.040	20.13	.00	.00
D 28	.997	23.49	.00	.00
D 29	1.028	19.54	2.40	.90
D 30	1.022	19.27	7.40	2.70
E 4	.982	32.51	47.80	20.00
E 5	.989	34.87	7.60	1.60
E 7	1.023	29.40	.00	.00
E 9	1.018	27.79	29.50	16.60
E 10	1.014	27.66	9.00	5.80
E 11	1.023	28.09	3.50	1.80
E 12	1.024	27.86	6.10	1.60
E 13	1.019	27.76	13.50	5.80
E 14	.999	26.71	14.90	5.00

Power Generated:	5628.61	2018.63
Power Demanded:	5468.80	2575.10
System Losses:	159.81	-556.47

Appendix M

250 Bus Network

M.1. Bus Oriented Results

```
    Time for input:  2.90
    Time for compact:   .23
    Time for factorization:   .29
No. of iterations:  8
Maximum mismatch (in pu):  2.2E-04 9.0E-04
    Time for solution:   .31
Execution time:  3.73

S base : 100.
```

Bus	Vsp	Voltage		Generation		QGmin	QGmax	Load	
BUS 69		1.035	30.00	210.58	-38.16				
BUS 1	.960	.960	18.25	.00	12.92	-5.00	35.00	51.00	27.00
BUS 4	.998	.998	23.78	50.00	-12.39	-300.00	300.00	30.00	12.00
BUS 6	.990	.990	20.67	.00	31.66	-13.00	50.00	52.00	22.00
BUS 8	1.015	1.015	29.48	40.00	144.85	-300.00	300.00	.00	10.00
BUS 10	1.055	1.055	44.39	450.00	34.26	-147.00	200.00	.00	.00
BUS 12	.990	.990	19.93	85.00	112.26	-35.00	120.00	47.00	20.00
BUS 15	.970	.970	18.73	.00	-5.46	-10.00	50.00	90.00	40.00
BUS 18	.973	.973	19.06	.00	8.47	-16.00	50.00	60.00	34.00
BUS 19	.960	.972+	18.39	.00	-8.00	-8.00	24.00	45.00	25.00
BUS 24	.992	.992	29.63	49.00	-10.32	-300.00	300.00	.00	.00
BUS 25	1.050	1.050	35.68	220.00	70.80	-47.00	140.00	.00	.00
BUS 26	1.015	1.015	37.40	314.00	10.30	-1000.00	1000.00	.00	.00
BUS 27	.968	.968	24.97	45.00	-9.98	-300.00	300.00	20.00	13.00
BUS 31	.967	.967	20.89	7.00	40.49	-300.00	300.00	43.00	27.00
BUS 32	.963	.964+	22.61	.00	-13.99	-14.00	42.00	59.00	23.00
BUS 34	.984	.987+	17.57	.00	-8.00	-8.00	24.00	59.00	26.00
BUS 36	.980	.980	17.17	.00	.67	-8.00	24.00	31.00	17.00
BUS 40	.970	.970	14.10	-46.00	-35.26	-300.00	300.00	20.00	23.00
BUS 42	.985	.985	14.36	-59.00	26.93	-300.00	300.00	37.00	23.00
BUS 46	1.080	1.080	22.48	89.00	91.60	-100.00	100.00	28.00	10.00
BUS 49	1.025	1.025	24.59	204.00	1.05	-85.00	210.00	87.00	30.00
BUS 54	.970	.970	21.69	48.00	-19.94	-300.00	300.00	113.00	52.00
BUS 55	.970	.970	21.47	.00	2.91	-8.00	23.00	63.00	22.00
BUS 56	.970	.974+	21.79	.00	-8.00	-8.00	15.00	84.00	38.00
BUS 59	.985	.985	23.83	155.00	42.51	-60.00	180.00	277.00	113.00
BUS 61	.995	.995	27.28	160.00	-13.97	-100.00	300.00	.00	.00
BUS 62	.998	.998	26.24	.00	20.71	-20.00	30.00	77.00	24.00
BUS 65	1.005	1.005	30.39	391.00	101.54	-67.00	200.00	.00	.00
BUS 66	1.050	1.050	29.55	392.00	38.65	-67.00	200.00	39.00	18.00
BUS 70	.984	.984+	26.99	.00	-9.95	-10.00	32.00	66.00	20.00
BUS 72	.980	.980	31.63	43.00	-23.87	-100.00	100.00	.00	.00
BUS 73	.991	.991	29.35	37.00	1.09	-100.00	100.00	.00	.00
BUS 74	.975	.975	24.18	.00	27.68	-6.00	39.00	68.00	27.00
BUS 76	.970	.970	24.27	.00	41.49	-8.00	80.00	68.00	37.00
BUS 77	1.006	1.006+	30.41	.00	-19.96	-20.00	70.00	61.00	20.00
BUS 80	1.040	1.040	33.32	477.00	174.50	-165.00	280.00	130.00	56.00
BUS 85	1.020	1.011-	36.26	.00	23.00	-8.00	23.00	24.00	15.00
BUS 87	1.015	1.015	35.39	4.00	-19.28	-100.00	1000.00	.00	.00
BUS 89	1.055	1.055	52.20	607.00	53.06	-210.00	300.00	.00	.00
BUS 90	.985	.985	41.63	-85.00	2.99	-300.00	300.00	78.00	52.00
BUS 91	.985	.985	40.85	20.00	-35.81	-100.00	100.00	.00	.00
BUS 92	1.030	1.022-	37.53	.00	20.00	-3.00	20.00	65.00	20.00
BUS 99	1.015	1.015	37.11	35.00	-25.06	-100.00	100.00	.00	.00
BUS 100	1.017	1.017	36.84	252.00	67.13	-50.00	155.00	37.00	18.00

Appendix L

250 Bus Network

Contingency AIII

L.1. Bus Oriended Results

```
    Time for input:  3.16
    Time for compact:   .24
    Time for factorization:   .29
No. of iterations:  7
Maximum mismatch (in pu):  3.2E-04 4.9E-04
    Time for solution:   .28
Execution time:  3.98

S base : 100.
```

Bus	Vsp	Voltage		Generation		QGmin	QGmax	Load	
BUS 69		1.035	30.00	202.61	-36.71				
BUS 1	.960	.960	18.29	.00	12.92	-5.00	35.00	51.00	27.00
BUS 4	.998	.998	23.82	50.00	-12.39	-300.00	300.00	30.00	12.00
BUS 6	.990	.990	20.71	.00	31.66	-13.00	50.00	52.00	22.00
BUS 8	1.015	1.015	29.52	40.00	144.85	-300.00	300.00	.00	10.00
BUS 10	1.055	1.055	44.43	450.00	34.26	-147.00	200.00	.00	.00
BUS 12	.990	.990	19.97	85.00	112.26	-35.00	120.00	47.00	20.00
BUS 15	.970	.970	18.77	.00	-5.46	-10.00	50.00	90.00	40.00
BUS 18	.973	.973	19.10	.00	8.47	-16.00	50.00	60.00	34.00
BUS 19	.960	.972+	18.43	.00	-8.00	-8.00	24.00	45.00	25.00
BUS 24	.992	.992	29.67	49.00	-10.32	-300.00	300.00	.00	.00
BUS 25	1.050	1.050	35.72	220.00	70.80	-47.00	140.00	.00	.00
BUS 26	1.015	1.015	37.45	314.00	10.31	-1000.00	1000.00	.00	.00
BUS 27	.968	.968	25.02	45.00	-9.98	-300.00	300.00	20.00	13.00
BUS 31	.967	.967	20.93	7.00	40.49	-300.00	300.00	43.00	27.00
BUS 32	.963	.964+	22.65	.00	-13.99	-14.00	42.00	59.00	23.00
BUS 34	.984	.987+	17.60	.00	-8.00	-8.00	24.00	59.00	26.00
BUS 36	.980	.980	17.21	.00	.68	-8.00	24.00	31.00	17.00
BUS 40	.970	.970	14.13	-46.00	-35.26	-300.00	300.00	20.00	23.00
BUS 42	.985	.985	14.40	-59.00	26.93	-300.00	300.00	37.00	23.00
BUS 46	1.080	1.080	22.51	89.00	91.59	-100.00	100.00	28.00	10.00
BUS 49	1.025	1.025	24.63	204.00	1.01	-85.00	210.00	87.00	30.00
BUS 54	.970	.970	21.73	48.00	-19.94	-300.00	300.00	113.00	52.00
BUS 55	.970	.970	21.51	.00	2.91	-8.00	23.00	63.00	22.00
BUS 56	.970	.974+	21.83	.00	-8.00	-8.00	15.00	84.00	38.00
BUS 59	.985	.985	23.87	155.00	42.51	-60.00	180.00	277.00	113.00
BUS 61	.995	.995	27.32	160.00	-13.97	-100.00	300.00	.00	.00
BUS 62	.998	.998	26.28	.00	20.71	-20.00	30.00	77.00	24.00
BUS 65	1.005	1.005	30.43	391.00	101.61	-67.00	200.00	.00	.00
BUS 66	1.050	1.050	29.59	392.00	38.64	-67.00	200.00	39.00	18.00
BUS 70	.984	.984+	27.04	.00	-10.00	-10.00	32.00	66.00	20.00
BUS 72	.980	.980	31.67	43.00	-23.87	-100.00	100.00	.00	.00
BUS 73	.991	.991	29.40	37.00	1.09	-100.00	100.00	.00	.00
BUS 74	.975	.975	24.26	.00	27.62	-6.00	39.00	68.00	27.00
BUS 76	.970	.970	24.41	.00	41.49	-8.00	80.00	68.00	37.00
BUS 77	1.006	1.006+	30.62	.00	-19.15	-20.00	70.00	61.00	20.00
BUS 80	1.040	1.040	33.45	477.00	173.84	-165.00	280.00	130.00	56.00
BUS 85	1.020	1.020	39.33	.00	6.14	-8.00	23.00	24.00	15.00
BUS 87	1.015	1.015	38.58	4.00	-22.23	-100.00	1000.00	.00	.00
BUS 89	1.055	1.055	48.99	607.00	71.43	-210.00	300.00	.00	.00
BUS 90	.985	.985	39.66	-85.00	-3.94	-300.00	300.00	78.00	52.00
BUS 91	.985	.985	39.57	20.00	-36.89	-100.00	100.00	.00	.00
BUS 92	1.030	1.022-	37.24	.00	20.00	-3.00	20.00	65.00	20.00
BUS 99	1.015	1.015	37.14	35.00	-25.11	-100.00	100.00	.00	.00
BUS 100	1.017	1.017	36.84	252.00	66.12	-50.00	155.00	37.00	18.00

BUS 103	1.000	1.000	35.31	40.00	31.40	-15.00	50.00	23.00	16.00
BUS 104	.971	.971	33.10	.00	6.57	-8.00	53.00	38.00	25.00
BUS 107	.980	.980	33.04	45.00	17.02	-200.00	200.00	28.00	12.00
BUS 111	.980	.980	35.66	36.00	4.66	-100.00	1000.00	.00	.00
BUS 112	.975	.975	35.27	55.00	11.36	-100.00	1000.00	25.00	13.00
BUS 116	1.005	1.005	29.42	-184.00	104.24	-1000.00	1000.00	.00	.00
A 1	1.050	1.050	21.32	100.00	4.11	-100.00	100.00	.00	.00
A 2	1.045	1.045	19.05	80.00	77.67	-20.00	80.00	21.70	12.70
A 5	1.010	1.010	15.67	50.00	32.51	-15.00	62.45	94.20	39.00
A 8	1.000	.998-	14.36	20.00	85.00	-15.00	85.00	30.00	30.00
A 11	1.050	1.050	16.03	20.00	8.48	-10.00	45.83	.00	.00
A 13	1.050	1.050	14.35	20.00	4.71	-15.00	56.57	.00	.00
B 1	1.050	1.050	20.11	100.00	69.35	-100.00	100.00	.00	.00
B 2	1.045	1.045	19.48	80.00	42.28	-20.00	60.00	21.70	12.70
B 5	1.010	1.010	15.68	50.00	36.83	-15.00	62.45	94.20	39.00
B 8	1.010	1.010	18.15	20.00	63.10	-15.00	75.00	30.00	30.00
B 11	1.050	1.050	18.69	20.00	7.06	-10.00	45.83	.00	.00
B 13	1.050	1.050	16.67	20.00	4.20	-15.00	56.57	.00	.00
C 1	1.050	1.050	39.97	100.00	42.95	-100.00	100.00	.00	.00
C 2	1.045	1.045	40.53	80.00	39.76	-20.00	60.00	21.70	12.70
C 5	1.010	1.010	38.11	50.00	16.04	-15.00	62.45	94.20	39.00
C 8	1.010	1.010	34.92	20.00	46.25	-15.00	75.00	30.00	30.00
C 11	1.050	1.050	36.18	20.00	6.85	-10.00	45.83	.00	.00
C 13	1.050	1.050	34.29	20.00	4.15	-15.00	56.57	.00	.00
D 1	1.025	1.021-	24.19	100.00	100.00	-100.00	100.00	.00	.00
D 2	1.020	1.020	25.26	80.00	9.60	-20.00	60.00	21.70	12.70
D 5	1.010	1.010	26.62	50.00	-1.21	-15.00	62.45	94.20	39.00
D 8	1.010	1.010	24.19	20.00	46.69	-15.00	75.00	30.00	30.00
D 11	1.050	1.050	24.35	20.00	8.35	-10.00	45.83	.00	.00
D 13	1.050	1.050	22.08	20.00	7.02	-15.00	56.57	.00	.00
E 1	1.060	1.059-	38.99	250.00	90.00	-40.00	90.00	20.00	12.00
E 2	1.045	1.028-	35.37	40.00	49.96	-40.00	50.00	21.70	12.70
E 3	.970	.970	28.75	.00	32.34	.00	70.00	94.20	39.00
E 6	1.040	1.040	28.78	.00	16.23	-6.00	34.00	11.20	7.50
E 8	1.050	1.050	29.40	.00	15.99	-6.00	34.00	.00	.00

Bus	Voltage		Load	
BUS 2	.973	18.93	20.00	9.00
BUS 3	.967	19.25	50.00	20.00
BUS 5	1.001	24.06	40.00	18.00
BUS 7	.987	20.07	51.00	14.00
BUS 9	1.034	36.88	.00	.00
BUS 11	.985	20.71	70.00	23.00
BUS 13	.968	19.24	34.00	16.00
BUS 14	.981	19.24	14.00	5.00
BUS 16	.984	19.64	25.00	10.00
BUS 17	.995	21.38	11.00	3.00
BUS 20	1.017	19.03	18.00	7.00
BUS 21	1.002	18.12	44.00	15.00
BUS 22	.995	19.43	45.00	13.00
BUS 23	.991	28.06	62.00	28.00
BUS 28	.960	22.73	17.00	7.00
BUS 29	.960	21.10	24.00	14.00
BUS 30	.985	26.38	.00	.00
BUS 33	.972	17.60	23.00	9.00
BUS 35	.980	17.22	33.00	19.00
BUS 37	.993	18.10	.00	.00
BUS 38	.964	23.02	.00	.00
BUS 39	.971	15.03	27.00	11.00
BUS 41	.967	13.46	37.00	10.00
BUS 43	.991	16.11	18.00	7.00
BUS 44	1.013	16.45	16.00	8.00
BUS 45	1.022	18.69	83.00	45.00
BUS 47	1.026	23.58	64.00	30.00
BUS 48	1.039	23.20	20.00	11.00
BUS 50	1.007	23.28	17.00	4.00
BUS 51	.986	22.05	17.00	8.00
BUS 52	.975	21.25	18.00	5.00
BUS 53	.962	20.62	23.00	11.00
BUS 57	.985	22.05	12.00	3.00
BUS 58	.979	21.67	12.00	3.00
BUS 60	.989	26.48	78.00	43.00
BUS 63	.970	26.49	.00	.00
BUS 64	.984	27.84	.00	.00
BUS 67	1.016	26.00	28.00	7.00
BUS 68	1.001	29.87	.00	.00
BUS 71	.987	28.42	.00	.00
BUS 75	.975	25.17	80.00	25.00
BUS 78	1.004	30.39	71.00	26.00
BUS 79	1.009	30.83	39.00	32.00
BUS 81	.993	31.25	.00	.00
BUS 82	1.003	33.49	54.00	27.00
BUS 83	1.007	34.92	20.00	10.00
BUS 84	1.011	37.68	11.00	7.00
BUS 86	1.022	38.06	21.00	10.00
BUS 88	1.024	44.12	48.00	25.00
BUS 93	1.010	36.01	12.00	7.00
BUS 94	1.005	35.37	30.00	16.00
BUS 95	.999	34.73	42.00	31.00
BUS 96	1.005	33.92	38.00	15.00
BUS 97	1.021	34.08	15.00	9.00
BUS 98	.991	32.66	64.00	48.00
BUS 101	1.018	36.70	22.00	15.00

BUS 102	1.037	37.76	25.00	3.00
BUS 105	.965	32.62	31.00	34.00
BUS 106	.957	32.06	69.00	36.00
BUS 108	.957	32.31	2.00	1.00
BUS 109	.954	32.22	48.00	10.00
BUS 110	.968	34.10	39.00	25.10
BUS 113	.993	21.41	6.00	-6.40
BUS 114	.957	22.58	20.00	3.00
BUS 115	.957	22.69	35.00	10.00
BUS 117	.974	18.43	20.00	8.00
BUS 118	.966	24.36	33.00	15.00
A 3	1.016	17.00	2.40	1.20
A 4	1.008	16.15	7.60	1.60
A 6	1.003	15.15	.00	.00
A 7	.998	14.74	22.80	10.90
A 9	1.034	13.83	.00	.00
A 10	1.031	11.96	5.80	2.00
A 12	1.044	12.89	11.20	7.50
A 14	1.029	11.96	6.20	1.60
A 15	1.025	11.81	8.20	2.50
A 16	1.032	12.23	3.50	1.80
A 17	1.026	11.86	9.00	5.80
A 18	1.015	11.15	3.20	.90
A 19	1.012	10.95	9.50	3.40
A 20	1.016	11.15	2.20	.70
A 21	1.020	11.49	17.50	11.20
A 22	1.021	11.50	.00	.00
A 23	1.017	11.33	3.20	1.60
A 24	1.013	11.03	8.70	6.70
A 25	1.021	11.13	.00	.00
A 26	1.005	10.65	3.50	2.30
A 27	1.035	11.46	.00	.00
A 28	.992	14.53	.00	.00
A 29	1.022	10.85	2.40	.90
A 30	1.017	10.58	7.40	2.70
B 3	1.017	18.33	2.40	1.20
B 4	1.010	18.04	7.60	1.60
B 6	1.008	17.88	.00	.00
B 7	1.001	16.46	22.80	10.90
B 9	1.037	16.50	.00	.00
B 10	1.034	14.61	5.80	2.00
B 12	1.045	15.20	11.20	7.50
B 14	1.030	14.34	6.20	1.60
B 15	1.027	14.24	8.20	2.50
B 16	1.033	14.69	3.50	1.80
B 17	1.029	14.46	9.00	5.80
B 18	1.017	13.66	3.20	.90
B 19	1.015	13.51	9.50	3.40
B 20	1.019	13.73	2.20	.70
B 21	1.023	14.17	17.50	11.20
B 22	1.024	14.19	.00	.00
B 23	1.019	13.92	3.20	1.60
B 24	1.017	13.85	8.70	6.70
B 25	1.026	14.43	.00	.00
B 26	1.010	13.95	3.50	2.30
B 27	1.040	15.05	.00	.00
B 28	.995	18.56	.00	.00
B 29	1.028	14.45	2.40	.90
B 30	1.023	14.19	7.40	2.70
C 3	1.016	36.54	2.40	1.20

C 4	1.008	35.89	7.60	1.60
C 6	1.008	35.41	.00	.00
C 7	1.001	35.82	22.80	10.90
C 9	1.037	33.99	.00	.00
C 10	1.035	32.06	5.80	2.00
C 12	1.045	32.83	11.20	7.50
C 14	1.030	31.92	6.20	1.60
C 15	1.027	31.79	8.20	2.50
C 16	1.034	32.25	3.50	1.80
C 17	1.030	31.94	9.00	5.80
C 18	1.018	31.17	3.20	.90
C 19	1.015	31.01	9.50	3.40
C 20	1.019	31.21	2.20	.70
C 21	1.024	31.58	17.50	11.20
C 22	1.025	31.58	.00	.00
C 23	1.019	31.31	3.20	1.60
C 24	1.018	31.04	8.70	6.70
C 25	1.028	31.01	.00	.00
C 26	1.012	30.53	3.50	2.30
C 27	1.043	31.26	.00	.00
C 28	1.003	34.23	.00	.00
C 29	1.031	30.66	2.40	.90
C 30	1.026	30.40	7.40	2.70
D 3	1.004	23.41	2.40	1.20
D 4	1.000	23.32	7.60	1.60
D 6	1.003	23.68	.00	.00
D 7	.998	24.18	22.80	10.90
D 9	1.034	22.16	.00	.00
D 10	1.032	20.18	5.80	2.00
D 12	1.041	20.61	11.20	7.50
D 14	1.026	19.75	6.20	1.60
D 15	1.023	19.66	8.20	2.50
D 16	1.030	20.17	3.50	1.80
D 17	1.026	20.00	9.00	5.80
D 18	1.014	19.13	3.20	.90
D 19	1.012	19.01	9.50	3.40
D 20	1.016	19.24	2.20	.70
D 21	1.020	19.71	17.50	11.20
D 22	1.021	19.72	.00	.00
D 23	1.016	19.34	3.20	1.60
D 24	1.014	19.26	8.70	6.70
D 25	1.025	19.63	.00	.00
D 26	1.009	19.16	3.50	2.30
D 27	1.040	20.13	.00	.00
D 28	.997	23.49	.00	.00
D 29	1.028	19.54	2.40	.90
D 30	1.022	19.27	7.40	2.70
E 4	.982	32.51	47.80	20.00
E 5	.989	34.87	7.60	1.60
E 7	1.023	29.40	.00	.00
E 9	1.018	27.79	29.50	16.60
E 10	1.014	27.66	9.00	5.80
E 11	1.023	28.09	3.50	1.80
E 12	1.024	27.86	6.10	1.60
E 13	1.019	27.76	13.50	5.80
E 14	.999	26.71	14.90	5.00

Power Generated:	5628.61	2018.63
Power Demanded:	5468.80	2575.10
System Losses:	159.81	-556.47

Appendix M

250 Bus Network

M.1. Bus Oriented Results

Time for input: 2.90
Time for compact: .23
Time for factorization: .29
No. of iterations: 8
Maximum mismatch (in pu): 2.2E-04 9.0E-04
Time for solution: .31
Execution time: 3.73

S base : 100.

Bus	Vsp	Voltage		Generation		QGmin	QGmax	Load	
BUS 69		1.035	30.00	210.58	-38.16				
BUS 1	.960	.960	18.25	.00	12.92	-5.00	35.00	51.00	27.00
BUS 4	.998	.998	23.78	50.00	-12.39	-300.00	300.00	30.00	12.00
BUS 6	.990	.990	20.67	.00	31.66	-13.00	50.00	52.00	22.00
BUS 8	1.015	1.015	29.48	40.00	144.85	-300.00	300.00	.00	10.00
BUS 10	1.055	1.055	44.39	450.00	34.26	-147.00	200.00	.00	.00
BUS 12	.990	.990	19.93	85.00	112.26	-35.00	120.00	47.00	20.00
BUS 15	.970	.970	18.73	.00	-5.46	-10.00	50.00	90.00	40.00
BUS 18	.973	.973	19.06	.00	8.47	-16.00	50.00	60.00	34.00
BUS 19	.960	.972+	18.39	.00	-8.00	-8.00	24.00	45.00	25.00
BUS 24	.992	.992	29.63	49.00	-10.32	-300.00	300.00	.00	.00
BUS 25	1.050	1.050	35.68	220.00	70.80	-47.00	140.00	.00	.00
BUS 26	1.015	1.015	37.40	314.00	10.30	-1000.00	1000.00	.00	.00
BUS 27	.968	.968	24.97	45.00	-9.98	-300.00	300.00	20.00	13.00
BUS 31	.967	.967	20.89	7.00	40.49	-300.00	300.00	43.00	27.00
BUS 32	.963	.964+	22.61	.00	-13.99	-14.00	42.00	59.00	23.00
BUS 34	.984	.987+	17.57	.00	-8.00	-8.00	24.00	59.00	26.00
BUS 36	.980	.980	17.17	.00	.67	-8.00	24.00	31.00	17.00
BUS 40	.970	.970	14.10	-46.00	-35.26	-300.00	300.00	20.00	23.00
BUS 42	.985	.985	14.36	-59.00	26.93	-300.00	300.00	37.00	23.00
BUS 46	1.080	1.080	22.48	89.00	91.60	-100.00	100.00	28.00	10.00
BUS 49	1.025	1.025	24.59	204.00	1.05	-85.00	210.00	87.00	30.00
BUS 54	.970	.970	21.69	48.00	-19.94	-300.00	300.00	113.00	52.00
BUS 55	.970	.970	21.47	.00	2.91	-8.00	23.00	63.00	22.00
BUS 56	.970	.974+	21.79	.00	-8.00	-8.00	15.00	84.00	38.00
BUS 59	.985	.985	23.83	155.00	42.51	-60.00	180.00	277.00	113.00
BUS 61	.995	.995	27.28	160.00	-13.97	-100.00	300.00	.00	.00
BUS 62	.998	.998	26.24	.00	20.71	-20.00	30.00	77.00	24.00
BUS 65	1.005	1.005	30.39	391.00	101.54	-67.00	200.00	.00	.00
BUS 66	1.050	1.050	29.55	392.00	38.65	-67.00	200.00	39.00	18.00
BUS 70	.984	.984+	26.99	.00	-9.95	-10.00	32.00	66.00	20.00
BUS 72	.980	.980	31.63	43.00	-23.87	-100.00	100.00	.00	.00
BUS 73	.991	.991	29.35	37.00	1.09	-100.00	100.00	.00	.00
BUS 74	.975	.975	24.18	.00	27.68	-6.00	39.00	68.00	27.00
BUS 76	.970	.970	24.27	.00	41.49	-8.00	80.00	68.00	37.00
BUS 77	1.006	1.006+	30.41	.00	-19.96	-20.00	70.00	61.00	20.00
BUS 80	1.040	1.040	33.32	477.00	174.50	-165.00	280.00	130.00	56.00
BUS 85	1.020	1.011-	36.26	.00	23.00	-8.00	23.00	24.00	15.00
BUS 87	1.015	1.015	35.39	4.00	-19.28	-100.00	1000.00	.00	.00
BUS 89	1.055	1.055	52.20	607.00	53.06	-210.00	300.00	.00	.00
BUS 90	.985	.985	41.63	-85.00	2.99	-300.00	300.00	78.00	52.00
BUS 91	.985	.985	40.85	20.00	-35.81	-100.00	100.00	.00	.00
BUS 92	1.030	1.022-	37.53	.00	20.00	-3.00	20.00	65.00	20.00
BUS 99	1.015	1.015	37.11	35.00	-25.06	-100.00	100.00	.00	.00
BUS 100	1.017	1.017	36.84	252.00	67.13	-50.00	155.00	37.00	18.00

BUS 103	1.000	1.000	35.31	40.00	31.40	-15.00	50.00	23.00	16.00
BUS 104	.971	.971	33.10	.00	6.57	-8.00	53.00	38.00	25.00
BUS 107	.980	.980	33.04	45.00	17.02	-200.00	200.00	28.00	12.00
BUS 111	.980	.980	35.66	36.00	4.66	-100.00	1000.00	.00	.00
BUS 112	.975	.975	35.27	55.00	11.36	-100.00	1000.00	25.00	13.00
BUS 116	1.005	1.005	29.38	-184.00	104.09	-1000.00	1000.00	.00	.00
A 1	1.050	1.050	21.29	100.00	4.11	-100.00	100.00	.00	.00
A 2	1.045	1.045	19.01	80.00	77.67	-20.00	80.00	21.70	12.70
A 5	1.010	1.010	15.63	50.00	32.51	-15.00	62.45	94.20	39.00
A 8	1.000	.998-	14.33	20.00	85.00	-15.00	85.00	30.00	30.00
A 11	1.050	1.050	15.99	20.00	8.48	-10.00	45.83	.00	.00
A 13	1.050	1.050	14.31	20.00	4.71	-15.00	56.57	.00	.00
B 1	1.050	1.050	20.07	100.00	69.35	-100.00	100.00	.00	.00
B 2	1.045	1.045	19.44	80.00	42.28	-20.00	60.00	21.70	12.70
B 5	1.010	1.010	15.64	50.00	36.83	-15.00	62.45	94.20	39.00
B 8	1.010	1.010	18.10	20.00	63.10	-15.00	75.00	30.00	30.00
B 11	1.050	1.050	18.65	20.00	7.06	-10.00	45.83	.00	.00
B 13	1.050	1.050	16.62	20.00	4.20	-15.00	56.57	.00	.00
C 1	1.050	1.050	40.02	100.00	43.76	-100.00	100.00	.00	.00
C 2	1.045	1.045	40.52	80.00	49.02	-20.00	60.00	21.70	12.70
C 5	1.010	1.010	35.78	50.00	34.91	-15.00	62.45	94.20	39.00
C 8	1.010	1.010	33.87	20.00	50.76	-15.00	75.00	30.00	30.00
C 11	1.050	1.050	35.43	20.00	6.99	-10.00	45.83	.00	.00
C 13	1.050	1.050	33.69	20.00	4.19	-15.00	56.57	.00	.00
D 1	1.025	1.021-	24.15	100.00	100.00	-100.00	100.00	.00	.00
D 2	1.020	1.020	25.22	80.00	9.60	-20.00	60.00	21.70	12.70
D 5	1.010	1.010	26.58	50.00	-1.21	-15.00	62.45	94.20	39.00
D 8	1.010	1.010	24.15	20.00	46.69	-15.00	75.00	30.00	30.00
D 11	1.050	1.050	24.31	20.00	8.35	-10.00	45.83	.00	.00
D 13	1.050	1.050	22.04	20.00	7.02	-15.00	56.57	.00	.00
E 1	1.060	1.058-	39.52	250.00	90.00	-40.00	90.00	20.00	12.00
E 2	1.045	1.028-	35.93	40.00	50.00	-40.00	50.00	21.70	12.70
E 3	.970	.970	29.51	.00	33.09	.00	70.00	94.20	39.00
E 6	1.040	1.040	29.89	.00	16.54	-6.00	34.00	11.20	7.50
E 8	1.050	1.050	30.43	.00	16.16	-6.00	34.00	.00	.00

Bus	Voltage		Load	
BUS 2	.973	18.89	20.00	9.00
BUS 3	.967	19.21	50.00	20.00
BUS 5	1.001	24.02	40.00	18.00
BUS 7	.987	20.03	51.00	14.00
BUS 9	1.034	36.84	.00	.00
BUS 11	.985	20.67	70.00	23.00
BUS 13	.968	19.20	34.00	16.00
BUS 14	.981	19.20	14.00	5.00
BUS 16	.984	19.60	25.00	10.00
BUS 17	.995	21.34	11.00	3.00
BUS 20	1.017	18.99	18.00	7.00
BUS 21	1.002	18.08	44.00	15.00
BUS 22	.995	19.38	45.00	13.00
BUS 23	.991	28.01	62.00	28.00
BUS 28	.960	22.68	17.00	7.00
BUS 29	.960	21.06	24.00	14.00
BUS 30	.985	26.34	.00	.00
BUS 33	.972	17.56	23.00	9.00
BUS 35	.980	17.18	33.00	19.00
BUS 37	.993	18.06	.00	.00
BUS 38	.964	22.98	.00	.00
BUS 39	.971	14.99	27.00	11.00
BUS 41	.967	13.42	37.00	10.00
BUS 43	.991	16.08	18.00	7.00
BUS 44	1.013	16.41	16.00	8.00
BUS 45	1.022	18.66	83.00	45.00
BUS 47	1.026	23.55	64.00	30.00
BUS 48	1.039	23.17	20.00	11.00
BUS 50	1.007	23.24	17.00	4.00
BUS 51	.986	22.01	17.00	8.00
BUS 52	.975	21.21	18.00	5.00
BUS 53	.962	20.58	23.00	11.00
BUS 57	.985	22.02	12.00	3.00
BUS 58	.979	21.63	12.00	3.00
BUS 60	.989	26.44	78.00	43.00
BUS 63	.970	26.45	.00	.00
BUS 64	.984	27.80	.00	.00
BUS 67	1.016	25.96	28.00	7.00
BUS 68	1.001	29.82	.00	.00
BUS 71	.987	28.38	.00	.00
BUS 75	.975	25.08	80.00	25.00
BUS 78	1.003	30.19	71.00	26.00
BUS 79	1.009	30.64	39.00	32.00
BUS 81	.993	31.17	.00	.00
BUS 82	1.002	32.70	54.00	27.00
BUS 83	1.005	33.58	20.00	10.00
BUS 84	1.005	35.17	11.00	7.00
BUS 86	1.016	34.91	21.00	10.00
BUS 88	.975	33.69	48.00	25.00
BUS 93	1.009	36.10	12.00	7.00
BUS 94	1.005	35.27	30.00	16.00
BUS 95	.998	34.45	42.00	31.00
BUS 96	1.005	33.60	38.00	15.00
BUS 97	1.020	34.13	15.00	9.00
BUS 98	.990	32.58	64.00	48.00
BUS 101	1.018	36.91	22.00	15.00

BUS 102	1.037	38.15	25.00	3.00
BUS 105	.965	32.63	31.00	34.00
BUS 106	.957	32.06	69.00	36.00
BUS 108	.957	32.31	2.00	1.00
BUS 109	.954	32.22	48.00	10.00
BUS 110	.968	34.10	39.00	25.10
BUS 113	.993	21.37	6.00	-6.40
BUS 114	.957	22.54	20.00	3.00
BUS 115	.957	22.65	35.00	10.00
BUS 117	.974	18.39	20.00	8.00
BUS 118	.966	24.25	33.00	15.00
A 3	1.016	16.97	2.40	1.20
A 4	1.008	16.12	7.60	1.60
A 6	1.003	15.11	.00	.00
A 7	.998	14.71	22.80	10.90
A 9	1.034	13.80	.00	.00
A 10	1.031	11.92	5.80	2.00
A 12	1.044	12.85	11.20	7.50
A 14	1.029	11.92	6.20	1.60
A 15	1.025	11.78	8.20	2.50
A 16	1.032	12.20	3.50	1.80
A 17	1.026	11.82	9.00	5.80
A 18	1.015	11.12	3.20	.90
A 19	1.012	10.92	9.50	3.40
A 20	1.016	11.11	2.20	.70
A 21	1.020	11.45	17.50	11.20
A 22	1.021	11.46	.00	.00
A 23	1.017	11.29	3.20	1.60
A 24	1.013	11.00	8.70	6.70
A 25	1.021	11.09	.00	.00
A 26	1.005	10.61	3.50	2.30
A 27	1.035	11.42	.00	.00
A 28	.992	14.49	.00	.00
A 29	1.022	10.82	2.40	.90
A 30	1.017	10.55	7.40	2.70
B 3	1.017	18.29	2.40	1.20
B 4	1.010	17.99	7.60	1.60
B 6	1.008	17.84	.00	.00
B 7	1.001	16.42	22.80	10.90
B 9	1.037	16.46	.00	.00
B 10	1.034	14.56	5.80	2.00
B 12	1.045	15.16	11.20	7.50
B 14	1.030	14.30	6.20	1.60
B 15	1.027	14.20	8.20	2.50
B 16	1.033	14.65	3.50	1.80
B 17	1.029	14.42	9.00	5.80
B 18	1.017	13.62	3.20	.90
B 19	1.015	13.47	9.50	3.40
B 20	1.019	13.68	2.20	.70
B 21	1.023	14.13	17.50	11.20
B 22	1.024	14.15	.00	.00
B 23	1.019	13.88	3.20	1.60
B 24	1.017	13.80	8.70	6.70
B 25	1.026	14.38	.00	.00
B 26	1.010	13.91	3.50	2.30
B 27	1.040	15.01	.00	.00
B 28	.995	18.52	.00	.00
B 29	1.028	14.41	2.40	.90
B 30	1.023	14.14	7.40	2.70
C 3	1.015	36.16	2.40	1.20

C 4	1.007	35.41	7.60	1.60
C 6	1.008	34.61	.00	.00
C 7	1.001	34.45	22.80	10.90
C 9	1.037	33.24	.00	.00
C 10	1.034	31.34	5.80	2.00
C 12	1.045	32.23	11.20	7.50
C 14	1.030	31.30	6.20	1.60
C 15	1.027	31.15	8.20	2.50
C 16	1.033	31.59	3.50	1.80
C 17	1.029	31.23	9.00	5.80
C 18	1.017	30.51	3.20	.90
C 19	1.015	30.32	9.50	3.40
C 20	1.019	30.52	2.20	.70
C 21	1.023	30.86	17.50	11.20
C 22	1.024	30.86	.00	.00
C 23	1.019	30.65	3.20	1.60
C 24	1.017	30.32	8.70	6.70
C 25	1.028	30.25	.00	.00
C 26	1.012	29.78	3.50	2.30
C 27	1.042	30.47	.00	.00
C 28	1.002	33.41	.00	.00
C 29	1.030	29.88	2.40	.90
C 30	1.025	29.61	7.40	2.70
D 3	1.004	23.37	2.40	1.20
D 4	1.000	23.28	7.60	1.60
D 6	1.003	23.64	.00	.00
D 7	.998	24.14	22.80	10.90
D 9	1.034	22.12	.00	.00
D 10	1.032	20.14	5.80	2.00
D 12	1.041	20.57	11.20	7.50
D 14	1.026	19.71	6.20	1.60
D 15	1.023	19.63	8.20	2.50
D 16	1.030	20.13	3.50	1.80
D 17	1.026	19.96	9.00	5.80
D 18	1.014	19.09	3.20	.90
D 19	1.012	18.97	9.50	3.40
D 20	1.016	19.21	2.20	.70
D 21	1.020	19.67	17.50	11.20
D 22	1.021	19.68	.00	.00
D 23	1.016	19.30	3.20	1.60
D 24	1.014	19.22	8.70	6.70
D 25	1.025	19.60	.00	.00
D 26	1.009	19.12	3.50	2.30
D 27	1.040	20.09	.00	.00
D 28	.997	23.45	.00	.00
D 29	1.028	19.50	2.40	.90
D 30	1.022	19.23	7.40	2.70
E 4	.981	33.51	47.80	20.00
E 5	.989	36.03	7.60	1.60
E 7	1.023	30.43	.00	.00
E 9	1.017	28.83	29.50	16.60
E 10	1.014	28.72	9.00	5.80
E 11	1.023	29.17	3.50	1.80
E 12	1.024	28.96	6.10	1.60
E 13	1.019	28.86	13.50	5.80
E 14	.999	27.77	14.90	5.00

Power Generated:	5636.58	2062.40
Power Demanded:	5468.80	2575.10
System Losses:	167.78	-512.70

Appendix N

250 Bus Network

N.1. Bus Oriented Results

Time for input: 2.98
Time for compact: .24
Time for factorization: .29
No. of iterations: 20
Maximum mismatch (in pu): 8.4E-05 8.3E-04
Time for solution: .64
Execution time: 4.15

S base : 100.

Bus	Vsp	Voltage		Generation		QGmin	QGmax	Load	
BUS 69		1.035	30.00	1131.31	-65.41				
BUS 1	.960	.950-	-22.73	.00	35.00	-5.00	35.00	63.75	37.80
BUS 4	.998	.998	-16.27	50.00	36.53	-300.00	300.00	37.50	16.80
BUS 6	.990	.983-	-19.67	.00	49.95	-13.00	50.00	65.00	30.80
BUS 8	1.015	1.015	-9.82	40.00	153.81	-300.00	300.00	.00	14.00
BUS 10	1.055	1.055	-.47	285.00	12.28	-147.00	200.00	.00	.00
BUS 12	.990	.978-	-20.03	85.00	120.00	-35.00	120.00	58.75	28.00
BUS 15	.970	.968-	-16.83	.00	50.00	-10.00	50.00	112.50	56.00
BUS 18	.973	.973	-16.34	.00	43.01	-16.00	50.00	75.00	47.60
BUS 19	.960	.968+	-16.90	.00	2.64	-8.00	24.00	56.25	35.00
BUS 24	.992	.992	2.96	49.00	36.35	-300.00	300.00	.00	.00
BUS 25	1.050	1.050	5.21	220.00	90.33	-47.00	140.00	.00	.00
BUS 26	1.015	1.015	7.68	420.00	34.01	-1000.00	1000.00	.00	.00
BUS 27	.968	.968	-9.07	45.00	13.43	-300.00	300.00	25.00	18.20
BUS 31	.967	.967	-14.20	7.00	66.08	-300.00	300.00	53.75	37.80
BUS 32	.963	.963	-11.84	.00	34.90	-14.00	42.00	73.75	32.20
BUS 34	.984	.974-	-9.61	.00	24.00	-8.00	24.00	73.75	36.40
BUS 36	.980	.968-	-10.11	.00	24.00	-8.00	24.00	38.75	23.80
BUS 40	.970	.970	-7.81	.00	6.74	-300.00	300.00	25.00	32.20
BUS 42	.985	.985	-4.51	.00	45.62	-300.00	300.00	46.25	32.20
BUS 46	1.080	1.059-	6.09	89.00	100.00	-100.00	100.00	35.00	14.00
BUS 49	1.025	1.025	9.73	300.00	108.77	-85.00	210.00	108.75	42.00
BUS 54	.970	.970	2.87	48.00	42.14	-300.00	300.00	141.25	72.80
BUS 55	.970	.969-	2.47	.00	23.00	-8.00	23.00	78.75	30.80
BUS 56	.970	.972+	2.97	.00	-6.37	-8.00	15.00	105.00	53.20
BUS 59	.985	.985	4.27	.00	152.67	-60.00	180.00	346.25	158.20
BUS 61	.995	.995	11.02	160.00	29.44	-100.00	300.00	.00	.00
BUS 62	.998	.995-	10.01	.00	30.00	-20.00	30.00	96.25	33.60
BUS 65	1.005	1.002-	19.15	500.00	200.00	-67.00	200.00	.00	.00
BUS 66	1.050	1.050	16.36	500.00	35.09	-67.00	200.00	48.75	25.20
BUS 70	.984	.981-	17.41	.00	32.00	-10.00	32.00	82.50	28.00
BUS 72	.980	.980	12.96	43.00	-15.01	-100.00	100.00	.00	.00
BUS 73	.991	.991	18.25	37.00	5.26	-100.00	100.00	.00	.00
BUS 74	.975	.961-	15.65	.00	39.00	-6.00	39.00	85.00	37.80
BUS 76	.970	.970-	15.05	.00	80.00	-8.00	80.00	85.00	51.80
BUS 77	1.006	1.006	21.55	.00	42.25	-20.00	70.00	76.25	28.00
BUS 80	1.040	1.040	23.07	300.00	266.08	-165.00	280.00	162.50	78.40
BUS 85	1.020	1.018-	27.11	.00	22.72	-8.00	23.00	30.00	21.00
BUS 87	1.015	1.015	25.97	4.00	-19.35	-100.00	1000.00	.00	.00
BUS 89	1.055	1.055	36.56	750.00	118.24	-210.00	300.00	.00	.00
BUS 90	.985	.985	30.41	.00	4.11	-300.00	300.00	97.50	72.80
BUS 91	.985	.985	31.85	20.00	-43.17	-100.00	100.00	.00	.00
BUS 92	1.030	1.030	31.62	.00	15.82	-3.00	20.00	81.25	28.00
BUS 99	1.015	1.015	28.11	35.00	-24.18	-100.00	100.00	.00	.00
BUS 100	1.017	1.017	28.36	350.00	87.14	-50.00	155.00	46.25	25.20

BUS 103	1.000	.999-	25.45	40.00	50.00	-15.00	50.00	28.75	22.40
BUS 104	.971	.971	22.42	.00	41.69	-8.00	53.00	47.50	35.00
BUS 107	.980	.980	21.47	45.00	35.21	-200.00	200.00	35.00	16.80
BUS 111	.980	.980	23.83	36.00	11.92	-100.00	1000.00	.00	.00
BUS 112	.975	.975	23.12	55.00	27.38	-100.00	1000.00	31.25	18.20
BUS 116	1.005	1.005	22.71	.00	105.58	-1000.00	1000.00	.00	.00
A 1	1.050	1.050	1.77	100.00	46.69	-100.00	100.00	.00	.00
A 2	1.045	1.030-	-.98	80.00	80.00	-20.00	80.00	27.13	17.78
A 5	1.010	.989-	-6.01	50.00	62.45	-15.00	62.45	117.75	54.60
A 8	1.000	.987-	-7.02	20.00	85.00	-15.00	85.00	37.50	42.00
A 11	1.050	1.050	-5.72	20.00	16.79	-10.00	45.83	.00	.00
A 13	1.050	1.050	-7.91	20.00	16.98	-15.00	56.57	.00	.00
B 1	1.050	1.049-	-17.66	100.00	100.00	-100.00	100.00	.00	.00
B 2	1.045	1.039-	-18.71	80.00	60.00	-20.00	60.00	27.13	17.78
B 5	1.010	.997-	-24.08	50.00	62.45	-15.00	62.45	117.75	54.60
B 8	1.010	.988-	-19.14	20.00	75.00	-15.00	75.00	37.50	42.00
B 11	1.050	1.050	-19.88	20.00	16.71	-10.00	45.83	.00	.00
B 13	1.050	1.050	-22.56	20.00	17.59	-15.00	56.57	.00	.00
C 1	1.050	1.050	31.58	100.00	33.82	-100.00	100.00	.00	.00
C 2	1.045	1.045-	30.32	80.00	59.54	-20.00	60.00	27.13	17.78
C 5	1.010	1.010	25.87	50.00	50.03	-15.00	62.45	117.75	54.60
C 8	1.010	1.004-	23.88	20.00	74.58	-15.00	75.00	37.50	42.00
C 11	1.050	1.050	24.65	20.00	13.68	-10.00	45.83	.00	.00
C 13	1.050	1.050	22.46	20.00	14.49	-15.00	56.57	.00	.00
D 1	1.025	1.019-	5.73	100.00	100.00	-100.00	100.00	.00	.00
D 2	1.020	1.020	7.21	80.00	28.60	-20.00	60.00	27.13	17.78
D 5	1.010	1.010	10.77	50.00	35.68	-15.00	62.45	117.75	54.60
D 8	1.010	1.006-	6.78	20.00	75.00	-15.00	75.00	37.50	42.00
D 11	1.050	1.050	5.63	20.00	14.59	-10.00	45.83	.00	.00
D 13	1.050	1.050	2.69	20.00	16.90	-15.00	56.57	.00	.00
E 1	1.060	1.055-	31.51	300.00	90.00	-40.00	90.00	25.00	16.80
E 2	1.045	1.017-	26.16	40.00	50.00	-40.00	50.00	27.13	17.78
E 3	.970	.968-	17.20	.00	70.00	.00	70.00	117.75	54.60
E 6	1.040	1.037-	17.25	.00	34.00	-6.00	34.00	14.00	10.50
E 8	1.050	1.050	18.23	.00	24.06	-6.00	34.00	.00	.00

Bus	Voltage		Load	
BUS 2	.960	-21.55	25.00	12.60
BUS 3	.955	-21.53	62.50	28.00
BUS 5	.999	-15.96	50.00	25.20
BUS 7	.977	-20.27	63.75	19.60
BUS 9	1.039	-5.22	.00	.00
BUS 11	.974	-19.29	87.50	32.20
BUS 13	.954	-20.01	42.50	22.40
BUS 14	.970	-19.70	17.50	7.00
BUS 16	.970	-18.94	31.25	14.00
BUS 17	.991	-13.55	13.75	4.20
BUS 20	1.010	-18.15	22.50	9.80
BUS 21	.983	-19.15	55.00	21.00
BUS 22	.969	-16.63	56.25	18.20
BUS 23	.978	-2.38	77.50	39.20
BUS 28	.957	-11.92	21.25	9.80
BUS 29	.958	-13.96	30.00	19.60
BUS 30	.974	-6.92	.00	.00
BUS 33	.958	-14.10	28.75	12.60
BUS 35	.967	-10.06	41.25	26.60
BUS 37	.979	-8.78	.00	.00
BUS 38	.940	-3.20	.00	.00
BUS 39	.964	-8.86	33.75	15.40
BUS 41	.964	-7.86	46.25	14.00
BUS 43	.967	-8.94	22.50	9.80
BUS 44	.986	-4.84	20.00	11.20
BUS 45	.992	-.46	103.75	63.00
BUS 47	1.005	9.88	80.00	42.00
BUS 48	1.031	7.09	25.00	15.40
BUS 50	1.003	7.29	21.25	5.60
BUS 51	.976	4.47	21.25	11.20
BUS 52	.963	3.26	22.50	7.00
BUS 53	.953	1.91	28.75	15.40
BUS 57	.980	4.33	15.00	4.20
BUS 58	.971	3.48	15.00	4.20
BUS 60	.986	9.87	97.50	60.20
BUS 63	.962	9.82	.00	.00
BUS 64	.978	12.79	.00	.00
BUS 67	1.012	10.13	35.00	9.80
BUS 68	1.001	22.73	.00	.00
BUS 71	.985	17.29	.00	.00
BUS 75	.961	17.35	100.00	35.00
BUS 78	1.000	21.04	88.75	36.40
BUS 79	1.004	21.13	48.75	44.80
BUS 81	.992	22.88	.00	.00
BUS 82	.993	23.03	67.50	37.80
BUS 83	.999	23.86	25.00	14.00
BUS 84	1.006	25.80	13.75	9.80
BUS 86	1.016	25.49	26.25	14.00
BUS 88	1.018	31.54	60.00	35.00
BUS 93	1.007	28.79	15.00	9.80
BUS 94	.998	26.81	37.50	22.40
BUS 95	.987	25.21	52.50	43.40
BUS 96	.994	24.09	47.50	21.00
BUS 97	1.012	24.23	18.75	12.60
BUS 98	.973	22.49	80.00	67.20
BUS 101	1.013	28.89	27.50	21.00

BUS 102	1.037	30.80	31.25	4.20
BUS 105	.957	21.67	38.75	47.60
BUS 106	.944	21.07	86.25	50.40
BUS 108	.947	20.82	2.50	1.40
BUS 109	.943	20.50	60.00	14.00
BUS 110	.962	22.35	48.75	35.14
BUS 113	.990	-13.51	7.50	-8.96
BUS 114	.954	-12.00	25.00	4.20
BUS 115	.953	-11.87	43.75	14.00
BUS 117	.955	-21.99	25.00	11.20
BUS 118	.956	15.71	41.25	21.00
A 3	1.003	-3.60	3.00	1.68
A 4	.993	-4.68	9.50	2.24
A 6	.988	-5.83	.00	.00
A 7	.977	-6.65	28.50	15.26
A 9	1.018	-7.96	.00	.00
A 10	1.006	-10.32	7.25	2.80
A 12	1.028	-9.40	14.00	10.50
A 14	1.006	-10.52	7.75	2.24
A 15	1.001	-10.66	10.25	3.50
A 16	1.009	-10.11	4.38	2.52
A 17	1.000	-10.48	11.25	8.12
A 18	.986	-11.46	4.00	1.26
A 19	.981	-11.68	11.88	4.76
A 20	.986	-11.41	2.75	.98
A 21	.990	-10.87	21.88	15.68
A 22	.991	-10.85	.00	.00
A 23	.987	-11.11	4.00	2.24
A 24	.980	-11.27	10.88	9.38
A 25	.992	-10.76	.00	.00
A 26	.970	-11.36	4.38	3.22
A 27	1.012	-10.12	.00	.00
A 28	.982	-5.75	.00	.00
A 29	.995	-10.88	3.00	1.26
A 30	.988	-11.23	9.25	3.78
B 3	1.003	-19.51	3.00	1.68
B 4	.993	-19.80	9.50	2.24
B 6	.989	-19.87	.00	.00
B 7	.980	-22.19	28.50	15.26
B 9	1.018	-22.11	.00	.00
B 10	1.006	-24.54	7.25	2.80
B 12	1.027	-24.05	14.00	10.50
B 14	1.005	-25.10	7.75	2.24
B 15	1.000	-25.18	10.25	3.50
B 16	1.009	-24.57	4.38	2.52
B 17	1.000	-24.76	11.25	8.12
B 18	.986	-25.87	4.00	1.26
B 19	.981	-26.03	11.88	4.76
B 20	.986	-25.73	2.75	.98
B 21	.990	-25.06	21.88	15.68
B 22	.991	-25.03	.00	.00
B 23	.986	-25.44	4.00	2.24
B 24	.979	-25.35	10.88	9.38
B 25	.991	-24.32	.00	.00
B 26	.969	-24.92	4.38	3.22
B 27	1.010	-23.36	.00	.00
B 28	.976	-18.55	.00	.00
B 29	.993	-24.13	3.00	1.26
B 30	.986	-24.48	9.25	3.78
C 3	1.007	26.62	3.00	1.68

C 4	.998	25.64	9.50	2.24
C 6	.999	24.61	.00	.00
C 7	.992	24.36	28.50	15.26
C 9	1.024	22.43	.00	.00
C 10	1.012	20.04	7.25	2.80
C 12	1.031	20.98	14.00	10.50
C 14	1.010	19.85	7.75	2.24
C 15	1.005	19.69	10.25	3.50
C 16	1.014	20.26	4.38	2.52
C 17	1.006	19.89	11.25	8.12
C 18	.991	18.91	4.00	1.26
C 19	.987	18.69	11.88	4.76
C 20	.992	18.96	2.75	.98
C 21	.997	19.47	21.88	15.68
C 22	.998	19.48	.00	.00
C 23	.992	19.18	4.00	2.24
C 24	.987	18.93	10.88	9.38
C 25	1.000	19.08	.00	.00
C 26	.978	18.49	4.38	3.22
C 27	1.020	19.51	.00	.00
C 28	.992	23.53	.00	.00
C 29	1.003	18.75	3.00	1.26
C 30	.996	18.41	9.25	3.78
D 3	.996	5.28	3.00	1.68
D 4	.992	5.27	9.50	2.24
D 6	.996	5.84	.00	.00
D 7	.989	6.96	28.50	15.26
D 9	1.022	3.41	.00	.00
D 10	1.011	.90	7.25	2.80
D 12	1.028	1.21	14.00	10.50
D 14	1.007	.17	7.75	2.24
D 15	1.003	.09	10.25	3.50
D 16	1.011	.76	4.38	2.52
D 17	1.004	.65	11.25	8.12
D 18	.989	-.54	4.00	1.26
D 19	.985	-.66	11.88	4.76
D 20	.990	-.35	2.75	.98
D 21	.995	.32	21.88	15.68
D 22	.996	.34	.00	.00
D 23	.990	-.23	4.00	2.24
D 24	.985	-.20	10.88	9.38
D 25	.998	.33	.00	.00
D 26	.977	-.26	4.38	3.22
D 27	1.019	.98	.00	.00
D 28	.989	5.35	.00	.00
D 29	1.002	.23	3.00	1.26
D 30	.995	-.12	9.25	3.78
E 4	.967	22.19	59.75	28.00
E 5	.979	25.10	9.50	2.24
E 7	1.010	18.23	.00	.00
E 9	.997	16.17	36.88	23.24
10	.994	15.99	11.25	8.12
11	1.010	16.47	4.38	2.52
12	1.015	16.10	7.63	2.24
13	1.007	16.01	16.88	8.12
14	.976	14.74	18.63	7.00

ower Generated:	7144.31	3835.33
ower Demanded:	6836.00	3605.14
stem Losses:	308.31	230.19

Appendix O

250 Bus Network

O.1. Bus Oriented Results

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    Time for input:  2.95
    Time for compact:   .26
    Time for factorization:   .29
No. of iterations: 13
Maximum mismatch (in pu):  8.2E-05 8.8E-04
    Time for solution:   .45
Execution time:  3.96

S base : 100.
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Bus	Vsp	Voltage		Generation		QGmin	QGmax	Load	
BUS 69		1.035	30.00	347.58	-54.16				
BUS 1	.960	.949-	7.80	.00	35.00	-5.00	35.00	63.75	37.80
BUS 4	.998	.998	15.07	50.00	34.41	-300.00	300.00	37.50	16.80
BUS 6	.990	.983-	11.07	.00	50.00	-13.00	50.00	65.00	30.80
BUS 8	1.015	1.015	22.90	40.00	242.31	-300.00	300.00	.00	14.00
BUS 10	1.055	1.055	41.91	570.00	60.69	-147.00	200.00	.00	.00
BUS 12	.990	.978-	9.97	85.00	120.00	-35.00	120.00	58.75	28.00
BUS 15	.970	.969-	8.07	.00	50.00	-10.00	50.00	112.50	56.00
BUS 18	.973	.973	8.20	.00	42.72	-16.00	50.00	75.00	47.60
BUS 19	.960	.968+	6.82	.00	2.03	-8.00	24.00	56.25	35.00
BUS 24	.992	.992	11.58	49.00	62.88	-300.00	300.00	.00	.00
BUS 25	1.050	1.050	38.01	220.00	33.48	-47.00	140.00	.00	.00
BUS 26	1.015	1.015	38.91	420.00	49.48	-1000.00	1000.00	.00	.00
BUS 27	.968	.968	13.92	45.00	52.33	-300.00	300.00	25.00	18.20
BUS 31	.967	.967	8.20	7.00	67.42	-300.00	300.00	53.75	37.80
BUS 32	.963	.961-	8.37	.00	42.00	-14.00	42.00	73.75	32.20
BUS 34	.984	.984	10.62	.00	18.63	-8.00	24.00	73.75	36.40
BUS 36	.980	.978-	10.13	.00	24.00	-8.00	24.00	38.75	23.80
BUS 40	.970	.970	9.29	.00	-6.96	-300.00	300.00	25.00	32.20
BUS 42	.985	.985	10.85	.00	36.47	-300.00	300.00	46.25	32.20
BUS 46	1.080	1.067-	18.17	89.00	99.20	-100.00	100.00	35.00	14.00
BUS 49	1.025	1.025	21.62	300.00	50.89	-85.00	210.00	108.75	42.00
BUS 54	.970	.970	16.13	48.00	39.94	-300.00	300.00	141.25	72.80
BUS 55	.970	.969-	15.83	.00	23.00	-8.00	23.00	78.75	30.80
BUS 56	.970	.972+	16.26	.00	-7.98	-8.00	15.00	105.00	53.20
BUS 59	.985	.985	18.98	155.00	109.66	-60.00	180.00	346.25	158.20
BUS 61	.995	.995	23.83	160.00	13.97	-100.00	300.00	.00	.00
BUS 62	.998	.996-	22.68	.00	30.00	-20.00	30.00	96.25	33.60
BUS 65	1.005	1.005	29.80	500.00	138.26	-67.00	200.00	.00	.00
BUS 66	1.050	1.050	27.92	500.00	28.34	-67.00	200.00	48.75	25.20
BUS 70	.984	.984	21.12	.00	25.82	-10.00	32.00	82.50	28.00
BUS 72	.980	.980	19.33	43.00	-20.23	-100.00	100.00	.00	.00
BUS 73	.991	.991	22.43	37.00	.98	-100.00	100.00	.00	.00
BUS 74	.975	.965-	19.66	.00	39.00	-6.00	39.00	85.00	37.80
BUS 76	.970	.970	20.92	.00	79.81	-8.00	80.00	85.00	51.80
BUS 77	1.006	1.006	29.86	.00	47.09	-20.00	70.00	76.25	28.00
BUS 80	1.040	1.040	34.01	600.00	215.65	-165.00	280.00	162.50	78.40
BUS 85	1.020	1.018-	37.02	.00	23.00	-8.00	23.00	30.00	21.00
BUS 87	1.015	1.015	35.88	4.00	-19.35	-100.00	1000.00	.00	.00
BUS 89	1.055	1.055	46.64	750.00	118.72	-210.00	300.00	.00	.00
BUS 90	.985	.985	40.56	.00	3.57	-300.00	300.00	97.50	72.80
BUS 91	.985	.985	41.99	20.00	-43.17	-100.00	100.00	.00	.00
BUS 92	1.030	1.030	41.75	.00	15.18	-3.00	20.00	81.25	28.00
BUS 99	1.015	1.015	38.64	35.00	-24.52	-100.00	100.00	.00	.00
BUS 100	1.017	1.017	38.71	350.00	86.18	-50.00	155.00	46.25	25.20

BUS 103	1.000	.999-	35.80	40.00	50.00	-15.00	50.00	28.75	22.40
BUS 104	.971	.971	32.77	.00	41.69	-8.00	53.00	47.50	35.00
BUS 107	.980	.980	31.82	45.00	35.21	-200.00	200.00	35.00	16.80
BUS 111	.980	.980	34.18	36.00	11.92	-100.00	1000.00	.00	.00
BUS 112	.975	.975	33.48	55.00	27.38	-100.00	1000.00	31.25	18.20
BUS 116	1.005	1.005	30.54	.00	89.63	-1000.00	1000.00	.00	.00
A 1	1.050	1.050	15.90	100.00	34.90	-100.00	100.00	.00	.00
A 2	1.045	1.033-	13.39	80.00	79.31	-20.00	80.00	27.13	17.78
A 5	1.010	.995-	8.89	50.00	62.14	-15.00	62.45	117.75	54.60
A 8	1.000	.989-	9.16	20.00	84.76	-15.00	85.00	37.50	42.00
A 11	1.050	1.050	9.70	20.00	16.01	-10.00	45.83	.00	.00
A 13	1.050	1.050	7.36	20.00	16.16	-15.00	56.57	.00	.00
B 1	1.050	1.047-	1.83	100.00	100.00	-100.00	100.00	.00	.00
B 2	1.045	1.037-	.35	80.00	60.00	-20.00	60.00	27.13	17.78
B 5	1.010	.995-	-5.34	50.00	62.45	-15.00	62.45	117.75	54.60
B 8	1.010	.987-	-1.34	20.00	75.00	-15.00	75.00	37.50	42.00
B 11	1.050	1.050	-1.44	20.00	17.31	-10.00	45.83	.00	.00
B 13	1.050	1.050	-4.05	20.00	18.26	-15.00	56.57	.00	.00
C 1	1.050	1.050	41.63	100.00	33.92	-100.00	100.00	.00	.00
C 2	1.045	1.045-	40.32	80.00	60.00	-20.00	60.00	27.13	17.78
C 5	1.010	1.010	35.79	50.00	50.11	-15.00	62.45	117.75	54.60
C 8	1.010	1.004-	33.67	20.00	75.00	-15.00	75.00	37.50	42.00
C 11	1.050	1.050	34.51	20.00	13.72	-10.00	45.83	.00	.00
C 13	1.050	1.050	32.37	20.00	14.48	-15.00	56.57	.00	.00
D 1	1.025	1.019-	18.80	100.00	99.99	-100.00	100.00	.00	.00
D 2	1.020	1.020	20.05	80.00	27.51	-20.00	60.00	27.13	17.78
D 5	1.010	1.010	22.86	50.00	32.87	-15.00	62.45	117.75	54.60
D 8	1.010	1.007-	19.46	20.00	74.99	-15.00	75.00	37.50	42.00
D 11	1.050	1.050	18.46	20.00	14.41	-10.00	45.83	.00	.00
D 13	1.050	1.050	15.53	20.00	16.72	-15.00	56.57	.00	.00
E 1	1.060	1.055-	41.75	300.00	90.00	-40.00	90.00	25.00	16.80
E 2	1.045	1.017-	36.46	40.00	49.97	-40.00	50.00	27.13	17.78
E 3	.970	.969-	27.47	.00	70.00	.00	70.00	117.75	54.60
E 6	1.040	1.037-	27.49	.00	34.00	-6.00	34.00	14.00	10.50
E 8	1.050	1.050	28.48	.00	23.98	-6.00	34.00	.00	.00

Bus	Voltage		Load	
BUS 2	.960	8.64	25.00	12.60
BUS 3	.955	9.14	62.50	28.00
BUS 5	.999	15.49	50.00	25.20
BUS 7	.976	10.19	63.75	19.60
BUS 9	1.028	32.29	.00	.00
BUS 11	.974	11.02	87.50	32.20
BUS 13	.954	9.06	42.50	22.40
BUS 14	.971	8.95	17.50	7.00
BUS 16	.971	9.58	31.25	14.00
BUS 17	.992	11.81	13.75	4.20
BUS 20	1.008	1.89	22.50	9.80
BUS 21	.981	-.73	55.00	21.00
BUS 22	.968	-.32	56.25	18.20
BUS 23	.959	7.53	77.50	39.20
BUS 28	.957	10.83	21.25	9.80
BUS 29	.958	8.52	30.00	19.60
BUS 30	.973	20.22	.00	.00
BUS 33	.966	8.61	28.75	12.60
BUS 35	.977	10.17	41.25	26.60
BUS 37	.989	11.43	.00	.00
BUS 38	.954	17.58	.00	.00
BUS 39	.967	9.38	33.75	15.40
BUS 41	.964	8.78	46.25	14.00
BUS 43	.977	9.12	22.50	9.80
BUS 44	.995	10.03	20.00	11.20
BUS 45	1.000	13.22	103.75	63.00
BUS 47	1.014	20.32	80.00	42.00
BUS 48	1.034	19.44	25.00	15.40
BUS 50	1.003	19.51	21.25	5.60
BUS 51	.977	17.16	21.25	11.20
BUS 52	.964	16.04	22.50	7.00
BUS 53	.953	14.97	28.75	15.40
BUS 57	.981	17.16	15.00	4.20
BUS 58	.972	16.42	15.00	4.20
BUS 60	.986	22.78	97.50	60.20
BUS 63	.967	23.03	.00	.00
BUS 64	.982	25.16	.00	.00
BUS 67	1.013	22.45	35.00	9.80
BUS 68	1.001	30.56	.00	.00
BUS 71	.987	21.46	.00	.00
BUS 75	.965	21.44	100.00	35.00
BUS 78	1.000	29.67	88.75	36.40
BUS 79	1.004	30.37	48.75	44.80
BUS 81	.993	31.89	.00	.00
BUS 82	.993	32.65	67.50	37.80
BUS 83	.999	33.60	25.00	14.00
BUS 84	1.005	35.66	13.75	9.80
BUS 86	1.016	35.41	26.25	14.00
BUS 88	1.018	41.55	60.00	35.00
BUS 93	1.007	38.95	15.00	9.80
BUS 94	.998	36.98	37.50	22.40
BUS 95	.987	35.31	52.50	43.40
BUS 96	.995	34.20	47.50	21.00
BUS 97	1.012	34.68	18.75	12.60
BUS 98	.973	33.22	80.00	67.20
BUS 101	1.013	39.17	27.50	21.00

BUS 102	1.037	41.01	31.25	4.20
BUS 105	.957	32.02	38.75	47.60
BUS 106	.944	31.42	86.25	50.40
BUS 108	.947	31.17	2.50	1.40
BUS 109	.943	30.85	60.00	14.00
BUS 110	.962	32.70	48.75	35.14
BUS 113	.990	11.21	7.50	-8.96
BUS 114	.952	9.38	25.00	4.20
BUS 115	.952	9.71	43.75	14.00
BUS 117	.955	8.01	25.00	11.20
BUS 118	.959	20.64	41.25	21.00
A 3	1.006	11.34	3.00	1.68
A 4	.996	10.45	9.50	2.24
A 6	.991	9.64	.00	.00
A 7	.981	8.61	28.50	15.26
A 9	1.019	7.47	.00	.00
A 10	1.008	5.09	7.25	2.80
A 12	1.029	5.88	14.00	10.50
A 14	1.007	4.78	7.75	2.24
A 15	1.002	4.65	10.25	3.50
A 16	1.010	5.23	4.38	2.52
A 17	1.002	4.91	11.25	8.12
A 18	.988	3.89	4.00	1.26
A 19	.983	3.69	11.88	4.76
A 20	.988	3.96	2.75	.98
A 21	.991	4.54	21.88	15.68
A 22	.993	4.56	.00	.00
A 23	.989	4.24	4.00	2.24
A 24	.982	4.13	10.88	9.38
A 25	.994	4.69	.00	.00
A 26	.972	4.10	4.38	3.22
A 27	1.014	5.36	.00	.00
A 28	.983	9.77	.00	.00
A 29	.997	4.60	3.00	1.26
A 30	.990	4.26	9.25	3.78
B 3	1.001	-.76	3.00	1.68
B 4	.991	-1.21	9.50	2.24
B 6	.987	-1.47	.00	.00
B 7	.978	-3.67	28.50	15.26
B 9	1.016	-3.68	.00	.00
B 10	1.004	-6.08	7.25	2.80
B 12	1.026	-5.54	14.00	10.50
B 14	1.004	-6.59	7.75	2.24
B 15	.999	-6.67	10.25	3.50
B 16	1.007	-6.08	4.38	2.52
B 17	.998	-6.30	11.25	8.12
B 18	.984	-7.39	4.00	1.26
B 19	.980	-7.56	11.88	4.76
B 20	.985	-7.26	2.75	.98
B 21	.988	-6.60	21.88	15.68
B 22	.989	-6.57	.00	.00
B 23	.985	-6.94	4.00	2.24
B 24	.978	-6.85	10.88	9.38
B 25	.989	-5.77	.00	.00
B 26	.967	-6.37	4.38	3.22
B 27	1.008	-4.77	.00	.00
B 28	.974	.10	.00	.00
B 29	.991	-5.54	3.00	1.26
B 30	.984	-5.90	9.25	3.78
C 3	1.007	36.60	3.00	1.68

C 4	.998	35.61	9.50	2.24
C 6	.999	34.47	.00	.00
C 7	.992	34.24	28.50	15.26
C 9	1.024	32.30	.00	.00
C 10	1.012	29.92	7.25	2.80
C 12	1.031	30.89	14.00	10.50
C 14	1.010	29.75	7.75	2.24
C 15	1.005	29.60	10.25	3.50
C 16	1.014	30.16	4.38	2.52
C 17	1.006	29.77	11.25	8.12
C 18	.991	28.80	4.00	1.26
C 19	.987	28.58	11.88	4.76
C 20	.992	28.84	2.75	.98
C 21	.996	29.34	21.88	15.68
C 22	.998	29.35	.00	.00
C 23	.992	29.06	4.00	2.24
C 24	.987	28.79	10.88	9.38
C 25	1.000	28.89	.00	.00
C 26	.978	28.30	4.38	3.22
C 27	1.019	29.28	.00	.00
C 28	.992	33.26	.00	.00
C 29	1.003	28.53	3.00	1.26
C 30	.996	28.19	9.25	3.78
D 3	.997	18.14	3.00	1.68
D 4	.992	18.09	9.50	2.24
D 6	.996	18.64	.00	.00
D 7	.990	19.49	28.50	15.26
D 9	1.022	16.23	.00	.00
D 10	1.011	13.73	7.25	2.80
D 12	1.028	14.05	14.00	10.50
D 14	1.007	13.01	7.75	2.24
D 15	1.003	12.93	10.25	3.50
D 16	1.012	13.60	4.38	2.52
D 17	1.005	13.48	11.25	8.12
D 18	.989	12.30	4.00	1.26
D 19	.985	12.18	11.88	4.76
D 20	.991	12.49	2.75	.98
D 21	.995	13.17	21.88	15.68
D 22	.996	13.18	.00	.00
D 23	.990	12.63	4.00	2.24
D 24	.985	12.68	10.88	9.38
D 25	.999	13.30	.00	.00
D 26	.978	12.72	4.38	3.22
D 27	1.020	14.01	.00	.00
D 28	.990	18.46	.00	.00
D 29	1.003	13.25	3.00	1.26
D 30	.996	12.91	9.25	3.78
E 4	.967	32.44	59.75	28.00
E 5	.979	35.33	9.50	2.24
E 7	1.010	28.48	.00	.00
E 9	.997	26.41	36.88	23.24
E 10	.994	26.24	11.25	8.12
E 11	1.010	26.71	4.38	2.52
E 12	1.016	26.34	7.63	2.24
E 13	1.007	26.25	16.88	8.12
E 14	.977	24.98	18.63	7.00

ower Generated:	7100.58	3699.52
ower Demanded:	6836.00	3605.14
ystem Losses:	264.58	94.38

Appendix P

250 Bus Network

Contingency BIII

P.1. Bus Oriented Results

```
    Time for input:  3.10
    Time for compact:   .25
    Time for factorization:   .30
No. of iterations: 14
Maximum mismatch (in pu):  1.6E-04 8.0E-04
    Time for solution:   .50
Execution time:  4.15

S base : 100.
```

Bus	Vsp	Voltage		Generation		QGmin	QGmax	Load	
BUS 69		1.035	30.00	343.91	-52.12				
BUS 1	.960	.950-	5.20	.00	35.00	-5.00	35.00	63.75	37.80
BUS 4	.998	.998	12.34	50.00	33.24	-300.00	300.00	37.50	16.80
BUS 6	.990	.983-	8.44	.00	50.00	-13.00	50.00	65.00	30.80
BUS 8	1.015	1.015	19.94	40.00	224.64	-300.00	300.00	.00	14.00
BUS 10	1.055	1.055	38.96	570.00	60.69	-147.00	200.00	.00	.00
BUS 12	.990	.978-	7.45	85.00	120.00	-35.00	120.00	58.75	28.00
BUS 15	.970	.970	6.45	.00	46.59	-10.00	50.00	112.50	56.00
BUS 18	.973	.973	6.72	.00	37.58	-16.00	50.00	75.00	47.60
BUS 19	.960	.968+	5.78	.00	-8.00	-8.00	24.00	56.25	35.00
BUS 24	.992	.992	19.87	49.00	12.52	-300.00	300.00	.00	.00
BUS 25	1.050	1.050	26.38	220.00	86.28	-47.00	140.00	.00	.00
BUS 26	1.015	1.015	29.56	420.00	23.26	-1000.00	1000.00	.00	.00
BUS 27	.968	.968	12.38	45.00	12.45	-300.00	300.00	25.00	18.20
BUS 31	.967	.967	7.84	7.00	63.97	-300.00	300.00	53.75	37.80
BUS 32	.963	.963	9.55	.00	26.26	-14.00	42.00	73.75	32.20
BUS 34	.984	.984	8.90	.00	14.99	-8.00	24.00	73.75	36.40
BUS 36	.980	.978-	8.39	.00	24.00	-8.00	24.00	38.75	23.80
BUS 40	.970	.970	7.91	.00	-7.71	-300.00	300.00	25.00	32.20
BUS 42	.985	.985	9.67	.00	37.15	-300.00	300.00	46.25	32.20
BUS 46	1.080	1.067-	17.31	89.00	100.00	-100.00	100.00	35.00	14.00
BUS 49	1.025	1.025	20.83	300.00	53.76	-85.00	210.00	108.75	42.00
BUS 54	.970	.970	15.37	48.00	39.91	-300.00	300.00	141.25	72.80
BUS 55	.970	.969-	15.08	.00	23.00	-8.00	23.00	78.75	30.80
BUS 56	.970	.972+	15.50	.00	-8.00	-8.00	15.00	105.00	53.20
BUS 59	.985	.985	18.24	155.00	109.67	-60.00	180.00	346.25	158.20
BUS 61	.995	.995	23.10	160.00	13.99	-100.00	300.00	.00	.00
BUS 62	.998	.996-	21.94	.00	30.00	-20.00	30.00	96.25	33.60
BUS 65	1.005	1.005	29.09	500.00	141.40	-67.00	200.00	.00	.00
BUS 66	1.050	1.050	27.18	500.00	28.25	-67.00	200.00	48.75	25.20
BUS 70	.984	.984	23.17	.00	17.55	-10.00	32.00	82.50	28.00
BUS 72	.980	.980	24.69	43.00	-23.32	-100.00	100.00	.00	.00
BUS 73	.991	.991	25.02	37.00	.95	-100.00	100.00	.00	.00
BUS 74	.975	.966-	20.80	.00	39.00	-6.00	39.00	85.00	37.80
BUS 76	.970	.970	21.38	.00	77.93	-8.00	80.00	85.00	51.80
BUS 77	1.006	1.006	29.75	.00	46.61	-20.00	70.00	76.25	28.00
BUS 80	1.040	1.040	33.56	600.00	218.63	-165.00	280.00	162.50	78.40
BUS 85	1.020	1.015-	40.25	.00	23.00	-8.00	23.00	30.00	21.00
BUS 87	1.015	1.015	39.08	4.00	-18.52	-100.00	1000.00	.00	.00
BUS 89	1.055	1.055	53.46	750.00	84.37	-210.00	300.00	.00	.00
BUS 90	.985	.985	43.40	.00	24.41	-300.00	300.00	97.50	72.80
BUS 91	.985	.985	41.92	20.00	-28.00	-100.00	100.00	.00	.00
BUS 92	1.030	1.013-	37.70	.00	20.00	-3.00	20.00	81.25	28.00
BUS 99	1.015	1.015	37.15	35.00	-25.17	-100.00	100.00	.00	.00
BUS 100	1.017	1.017	36.80	350.00	102.28	-50.00	155.00	46.25	25.20

BÚS 103	1.000	.999-	33.89	40.00	50.00	-15.00	50.00	28.75	22.40
BUS 104	.971	.971	30.86	.00	41.69	-8.00	53.00	47.50	35.00
BUS 107	.980	.980	29.91	45.00	35.21	-200.00	200.00	35.00	16.80
BUS 111	.980	.980	32.27	36.00	11.92	-100.00	1000.00	.00	.00
BUS 112	.975	.975	31.56	55.00	27.38	-100.00	1000.00	31.25	18.20
BUS 116	1.005	1.005	30.06	.00	88.33	-1000.00	1000.00	.00	.00
A 1	1.050	1.050	14.85	100.00	35.23	-100.00	100.00	.00	.00
A 2	1.045	1.033-	12.32	80.00	80.00	-20.00	80.00	27.13	17.78
A 5	1.010	.995-	7.75	50.00	62.45	-15.00	62.45	117.75	54.60
A 8	1.000	.989-	7.88	20.00	85.00	-15.00	85.00	37.50	42.00
A 11	1.050	1.050	8.51	20.00	16.03	-10.00	45.83	.00	.00
A 13	1.050	1.050	6.19	20.00	16.18	-15.00	56.57	.00	.00
B 1	1.050	1.050	3.98	100.00	98.76	-100.00	100.00	.00	.00
B 2	1.045	1.040-	2.81	80.00	60.00	-20.00	60.00	27.13	17.78
B 5	1.010	.998-	-2.63	50.00	62.45	-15.00	62.45	117.75	54.60
B 8	1.010	.991-	2.07	20.00	75.00	-15.00	75.00	37.50	42.00
B 11	1.050	1.050	1.47	20.00	16.24	-10.00	45.83	.00	.00
B 13	1.050	1.050	-1.17	20.00	17.03	-15.00	56.57	.00	.00
C 1	1.050	1.050	40.30	100.00	66.80	-100.00	100.00	.00	.00
C 2	1.045	1.043-	41.11	80.00	60.00	-20.00	60.00	27.13	17.78
C 5	1.010	1.010	38.14	50.00	59.32	-15.00	62.45	117.75	54.60
C 8	1.010	1.001-	34.36	20.00	75.00	-15.00	75.00	37.50	42.00
C 11	1.050	1.050	34.88	20.00	14.37	-10.00	45.83	.00	.00
C 13	1.050	1.050	32.46	20.00	15.47	-15.00	56.57	.00	.00
D 1	1.025	1.019-	18.04	100.00	100.00	-100.00	100.00	.00	.00
D 2	1.020	1.020	19.29	80.00	27.51	-20.00	60.00	27.13	17.78
D 5	1.010	1.010	22.11	50.00	32.88	-15.00	62.45	117.75	54.60
D 8	1.010	1.007-	18.71	20.00	75.00	-15.00	75.00	37.50	42.00
D 11	1.050	1.050	17.71	20.00	14.41	-10.00	45.83	.00	.00
D 13	1.050	1.050	14.78	20.00	16.72	-15.00	56.57	.00	.00
E 1	1.060	1.048-	40.28	300.00	90.00	-40.00	90.00	25.00	16.80
E 2	1.045	1.014-	35.85	40.00	50.00	-40.00	50.00	27.13	17.78
E 3	.970	.964-	27.30	.00	70.00	.00	70.00	117.75	54.60
E 6	1.040	1.034-	28.06	.00	34.00	-6.00	34.00	14.00	10.50
E 8	1.050	1.050	28.87	.00	25.49	-6.00	34.00	.00	.00

Bus	Voltage		Load	
BUS 2	.960	6.09	25.00	12.60
BUS 3	.955	6.52	62.50	28.00
BUS 5	.999	12.74	50.00	25.20
BUS 7	.977	7.60	63.75	19.60
BUS 9	1.028	29.34	.00	.00
BUS 11	.974	8.45	87.50	32.20
BUS 13	.954	6.72	42.50	22.40
BUS 14	.971	6.67	17.50	7.00
BUS 16	.972	7.24	31.25	14.00
BUS 17	.994	9.83	13.75	4.20
BUS 20	1.011	3.62	22.50	9.80
BUS 21	.985	2.24	55.00	21.00
BUS 22	.973	4.26	56.25	18.20
BUS 23	.981	17.00	77.50	39.20
BUS 28	.957	9.76	21.25	9.80
BUS 29	.958	7.98	30.00	19.60
BUS 30	.980	16.85	.00	.00
BUS 33	.966	6.93	28.75	12.60
BUS 35	.977	8.43	41.25	26.60
BUS 37	.989	9.66	.00	.00
BUS 38	.956	15.49	.00	.00
BUS 39	.967	7.86	33.75	15.40
BUS 41	.964	7.46	46.25	14.00
BUS 43	.977	7.64	22.50	9.80
BUS 44	.994	8.89	20.00	11.20
BUS 45	1.000	12.21	103.75	63.00
BUS 47	1.014	19.61	80.00	42.00
BUS 48	1.033	18.59	25.00	15.40
BUS 50	1.003	18.73	21.25	5.60
BUS 51	.977	16.39	21.25	11.20
BUS 52	.964	15.28	22.50	7.00
BUS 53	.953	14.21	28.75	15.40
BUS 57	.981	16.40	15.00	4.20
BUS 58	.972	15.66	15.00	4.20
BUS 60	.986	22.05	97.50	60.20
BUS 63	.967	22.30	.00	.00
BUS 64	.982	24.44	.00	.00
BUS 67	1.013	21.70	35.00	9.80
BUS 68	1.001	30.08	.00	.00
BUS 71	.987	24.05	.00	.00
BUS 75	.966	22.28	100.00	35.00
BUS 78	1.000	29.52	88.75	36.40
BUS 79	1.004	30.14	48.75	44.80
BUS 81	.993	31.43	.00	.00
BUS 82	.990	32.93	67.50	37.80
BUS 83	.995	34.61	25.00	14.00
BUS 84	1.002	38.17	13.75	9.80
BUS 86	1.014	38.61	26.25	14.00
BUS 88	1.013	46.93	60.00	35.00
BUS 93	.998	36.08	15.00	9.80
BUS 94	.994	35.20	37.50	22.40
BUS 95	.984	34.36	52.50	43.40
BUS 96	.992	33.56	47.50	21.00
BUS 97	1.010	34.11	18.75	12.60
BUS 98	.974	32.23	80.00	67.20
BUS 101	1.007	36.93	27.50	21.00

BUS 102	1.026	38.51	31.25	4.20
BUS 105	.957	30.11	38.75	47.60
BUS 106	.944	29.51	86.25	50.40
BUS 108	.947	29.26	2.50	1.40
BUS 109	.943	28.94	60.00	14.00
BUS 110	.962	30.79	48.75	35.14
BUS 113	.992	9.63	7.50	-8.96
BUS 114	.954	9.41	25.00	4.20
BUS 115	.953	9.55	43.75	14.00
BUS 117	.955	5.49	25.00	11.20
BUS 118	.959	21.30	41.25	21.00
A 3	1.006	10.21	3.00	1.68
A 4	.996	9.29	9.50	2.24
A 6	.991	8.44	.00	.00
A 7	.981	7.44	28.50	15.26
A 9	1.019	6.28	.00	.00
A 10	1.007	3.90	7.25	2.80
A 12	1.029	4.71	14.00	10.50
A 14	1.007	3.60	7.75	2.24
A 15	1.002	3.48	10.25	3.50
A 16	1.010	4.05	4.38	2.52
A 17	1.002	3.73	11.25	8.12
A 18	.988	2.71	4.00	1.26
A 19	.983	2.51	11.88	4.76
A 20	.988	2.78	2.75	.98
A 21	.991	3.35	21.88	15.68
A 22	.993	3.37	.00	.00
A 23	.989	3.06	4.00	2.24
A 24	.982	2.94	10.88	9.38
A 25	.994	3.50	.00	.00
A 26	.972	2.91	4.38	3.22
A 27	1.013	4.17	.00	.00
A 28	.983	8.57	.00	.00
A 29	.997	3.41	3.00	1.26
A 30	.990	3.06	9.25	3.78
B 3	1.004	1.94	3.00	1.68
B 4	.995	1.60	9.50	2.24
B 6	.990	1.47	.00	.00
B 7	.982	-.81	28.50	15.26
B 9	1.019	-.76	.00	.00
B 10	1.007	-3.17	7.25	2.80
B 12	1.028	-2.66	14.00	10.50
B 14	1.006	-3.71	7.75	2.24
B 15	1.001	-3.79	10.25	3.50
B 16	1.009	-3.19	4.38	2.52
B 17	1.001	-3.39	11.25	8.12
B 18	.987	-4.49	4.00	1.26
B 19	.982	-4.65	11.88	4.76
B 20	.987	-4.36	2.75	.98
B 21	.991	-3.70	21.88	15.68
B 22	.992	-3.67	.00	.00
B 23	.987	-4.06	4.00	2.24
B 24	.980	-3.98	10.88	9.38
B 25	.992	-2.97	.00	.00
B 26	.970	-3.56	4.38	3.22
B 27	1.011	-2.02	.00	.00
B 28	.978	2.78	.00	.00
B 29	.994	-2.79	3.00	1.26
B 30	.987	-3.13	9.25	3.78
C 3	1.005	36.28	3.00	1.68

C 4	.996	35.51	9.50	2.24
C 6	.997	34.94	.00	.00
C 7	.990	35.41	28.50	15.26
C 9	1.022	32.66	.00	.00
C 10	1.011	30.22	7.25	2.80
C 12	1.030	30.98	14.00	10.50
C 14	1.009	29.87	7.75	2.24
C 15	1.004	29.73	10.25	3.50
C 16	1.012	30.34	4.38	2.52
C 17	1.005	30.04	11.25	8.12
C 18	.990	28.99	4.00	1.26
C 19	.986	28.81	11.88	4.76
C 20	.991	29.09	2.75	.98
C 21	.995	29.63	21.88	15.68
C 22	.996	29.65	.00	.00
C 23	.991	29.25	4.00	2.24
C 24	.985	29.05	10.88	9.38
C 25	.998	29.21	.00	.00
C 26	.976	28.62	4.38	3.22
C 27	1.017	29.63	.00	.00
C 28	.990	33.66	.00	.00
C 29	1.000	28.87	3.00	1.26
C 30	.993	28.53	9.25	3.78
D 3	.997	17.39	3.00	1.68
D 4	.992	17.34	9.50	2.24
D 6	.996	17.89	.00	.00
D 7	.990	18.74	28.50	15.26
D 9	1.022	15.48	.00	.00
D 10	1.011	12.98	7.25	2.80
D 12	1.028	13.29	14.00	10.50
D 14	1.007	12.26	7.75	2.24
D 15	1.003	12.18	10.25	3.50
D 16	1.012	12.85	4.38	2.52
D 17	1.005	12.73	11.25	8.12
D 18	.989	11.55	4.00	1.26
D 19	.985	11.43	11.88	4.76
D 20	.991	11.74	2.75	.98
D 21	.995	12.42	21.88	15.68
D 22	.996	12.43	.00	.00
D 23	.990	11.88	4.00	2.24
D 24	.985	11.93	10.88	9.38
D 25	.999	12.55	.00	.00
D 26	.978	11.97	4.38	3.22
D 27	1.020	13.26	.00	.00
D 28	.990	17.71	.00	.00
29	1.003	12.51	3.00	1.26
30	.996	12.16	9.25	3.78
4	.963	32.80	59.75	28.00
5	.975	36.06	9.50	2.24
7	1.007	28.87	.00	.00
9	.994	26.82	36.88	23.24
10	.990	26.67	11.25	8.12
11	1.007	27.21	4.38	2.52
12	1.012	26.89	7.63	2.24
13	1.004	26.79	16.88	8.12
14	.973	25.44	18.63	7.00

ower Generated:	7096.91	3638.37
ower Demanded:	6836.00	3605.14
ystem Losses:	260.91	33.23

Appendix Q

250 Bus Results

Contingency BIV

Q.1. Bus Oriented Results

```
    Time for input:  2.92
    Time for compact:   .24
    Time for factorization:   .29
No. of iterations: 22
Maximum mismatch (in pu):  5.6E-05 8.1E-04
    Time for solution:   .76
Execution time:  4.21

S base : 100.
```

Bus	Vsp	Voltage		Generation		QGmin	QGmax	Load	
BUS 69		1.035	30.00	359.99	-54.73				
BUS 1	.960	.950-	5.11	.00	35.00	-5.00	35.00	63.75	37.80
BUS 4	.998	.998	12.25	50.00	33.24	-300.00	300.00	37.50	16.80
BUS 6	.990	.983-	8.35	.00	50.00	-13.00	50.00	65.00	30.80
BUS 8	1.015	1.015	19.85	40.00	224.64	-300.00	300.00	.00	14.00
BUS 10	1.055	1.055	38.87	570.00	60.69	-147.00	200.00	.00	.00
BUS 12	.990	.978-	7.36	85.00	120.00	-35.00	120.00	58.75	28.00
BUS 15	.970	.970	6.36	.00	46.59	-10.00	50.00	112.50	56.00
BUS 18	.973	.973	6.63	.00	37.58	-16.00	50.00	75.00	47.60
BUS 19	.960	.968+	5.70	.00	-8.00	-8.00	24.00	56.25	35.00
BUS 24	.992	.992	19.78	49.00	12.51	-300.00	300.00	.00	.00
BUS 25	1.050	1.050	26.29	220.00	86.28	-47.00	140.00	.00	.00
BUS 26	1.015	1.015	29.47	420.00	23.26	-1000.00	1000.00	.00	.00
BUS 27	.968	.968	12.29	45.00	12.44	-300.00	300.00	25.00	18.20
BUS 31	.967	.967	7.75	7.00	63.97	-300.00	300.00	53.75	37.80
BUS 32	.963	.963	9.46	.00	26.26	-14.00	42.00	73.75	32.20
BUS 34	.984	.984	8.81	.00	14.99	-8.00	24.00	73.75	36.40
BUS 36	.980	.978-	8.31	.00	24.00	-8.00	24.00	38.75	23.80
BUS 40	.970	.970	7.83	.00	-7.71	-300.00	300.00	25.00	32.20
BUS 42	.985	.985	9.59	.00	37.16	-300.00	300.00	46.25	32.20
BUS 46	1.080	1.067-	17.24	89.00	100.00	-100.00	100.00	35.00	14.00
BUS 49	1.025	1.025	20.76	300.00	53.92	-85.00	210.00	108.75	42.00
BUS 54	.970	.970	15.29	48.00	39.92	-300.00	300.00	141.25	72.80
BUS 55	.970	.969-	14.99	.00	23.00	-8.00	23.00	78.75	30.80
BUS 56	.970	.972+	15.42	.00	-7.99	-8.00	15.00	105.00	53.20
BUS 59	.985	.985	18.15	155.00	109.67	-60.00	180.00	346.25	158.20
BUS 61	.995	.995	23.01	160.00	13.98	-100.00	300.00	.00	.00
BUS 62	.998	.996-	21.86	.00	30.00	-20.00	30.00	96.25	33.60
BUS 65	1.005	1.005	28.99	500.00	141.19	-67.00	200.00	.00	.00
BUS 66	1.050	1.050	27.09	500.00	28.27	-67.00	200.00	48.75	25.20
BUS 70	.984	.984	23.07	.00	17.73	-10.00	32.00	82.50	28.00
BUS 72	.980	.980	24.60	43.00	-23.32	-100.00	100.00	.00	.00
BUS 73	.991	.991	24.93	37.00	.95	-100.00	100.00	.00	.00
BUS 74	.975	.966-	20.65	.00	39.00	-6.00	39.00	85.00	37.80
BUS 76	.970	.970	21.12	.00	77.75	-8.00	80.00	85.00	51.80
BUS 77	1.006	1.006	29.35	.00	55.54	-20.00	70.00	76.25	28.00
BUS 80	1.040	1.040	33.28	600.00	223.78	-165.00	280.00	162.50	78.40
BUS 85	1.020	.980-	36.15	.00	23.00	-8.00	23.00	30.00	21.00
BUS 87	1.015	1.015	34.50	4.00	-7.31	-100.00	1000.00	.00	.00
BUS 89	1.055	1.055	57.82	750.00	87.41	-210.00	300.00	.00	.00
BUS 90	.985	.985	46.01	.00	39.25	-300.00	300.00	97.50	72.80
BUS 91	.985	.985	43.55	20.00	-24.30	-100.00	100.00	.00	.00
BUS 92	1.030	1.011-	37.95	.00	20.00	-3.00	20.00	81.25	28.00
BUS 99	1.015	1.015	36.95	35.00	-25.12	-100.00	100.00	.00	.00
BUS 100	1.017	1.017	36.64	350.00	109.60	-50.00	155.00	46.25	25.20

BUS 103	1.000	.999-	33.73	40.00	50.00	-15.00	50.00	28.75	22.40
BUS 104	.971	.971	30.70	.00	41.69	-8.00	53.00	47.50	35.00
BUS 107	.980	.980	29.75	45.00	35.21	-200.00	200.00	35.00	16.80
BUS 111	.980	.980	32.11	36.00	11.92	-100.00	1000.00	.00	.00
BUS 112	.975	.975	31.40	55.00	27.38	-100.00	1000.00	31.25	18.20
BUS 116	1.005	1.005	29.97	.00	87.98	-1000.00	1000.00	.00	.00
A 1	1.050	1.050	14.78	100.00	35.25	-100.00	100.00	.00	.00
A 2	1.045	1.033-	12.24	80.00	80.00	-20.00	80.00	27.13	17.78
A 5	1.010	.995-	7.67	50.00	62.45	-15.00	62.45	117.75	54.60
A 8	1.000	.989-	7.80	20.00	85.00	-15.00	85.00	37.50	42.00
A 11	1.050	1.050	8.43	20.00	16.03	-10.00	45.83	.00	.00
A 13	1.050	1.050	6.11	20.00	16.18	-15.00	56.57	.00	.00
B 1	1.050	1.050	3.89	100.00	98.75	-100.00	100.00	.00	.00
B 2	1.045	1.040-	2.72	80.00	60.00	-20.00	60.00	27.13	17.78
B 5	1.010	.998-	-2.71	50.00	62.45	-15.00	62.45	117.75	54.60
B 8	1.010	.991-	1.98	20.00	75.00	-15.00	75.00	37.50	42.00
B 11	1.050	1.050	1.38	20.00	16.24	-10.00	45.83	.00	.00
B 13	1.050	1.050	-1.26	20.00	17.03	-15.00	56.57	.00	.00
C 1	1.050	1.050	40.19	100.00	91.35	-100.00	100.00	.00	.00
C 2	1.045	1.033-	41.10	80.00	60.00	-20.00	60.00	27.13	17.78
C 5	1.010	.984-	35.08	50.00	62.45	-15.00	62.45	117.75	54.60
C 8	1.010	.989-	32.85	20.00	75.00	-15.00	75.00	37.50	42.00
C 11	1.050	1.050	33.73	20.00	17.49	-10.00	45.83	.00	.00
C 13	1.050	1.050	31.45	20.00	18.48	-15.00	56.57	.00	.00
D 1	1.025	1.019-	17.96	100.00	99.99	-100.00	100.00	.00	.00
D 2	1.020	1.020	19.21	80.00	27.51	-20.00	60.00	27.13	17.78
D 5	1.010	1.010	22.02	50.00	32.88	-15.00	62.45	117.75	54.60
D 8	1.010	1.007-	18.63	20.00	75.00	-15.00	75.00	37.50	42.00
D 11	1.050	1.050	17.62	20.00	14.41	-10.00	45.83	.00	.00
D 13	1.050	1.050	14.70	20.00	16.72	-15.00	56.57	.00	.00
E 1	1.060	1.045-	40.89	300.00	90.00	-40.00	90.00	25.00	16.80
E 2	1.045	1.011-	36.49	40.00	50.00	-40.00	50.00	27.13	17.78
E 3	.970	.961-	28.20	.00	70.00	.00	70.00	117.75	54.60
E 6	1.040	1.031-	29.43	.00	34.00	-6.00	34.00	14.00	10.50
E 8	1.050	1.050	30.12	.00	26.60	-6.00	34.00	.00	.00

Bus	Voltage		Load	
BUS 2	.960	6.01	25.00	12.60
BUS 3	.955	6.43	62.50	28.00
BUS 5	.999	12.65	50.00	25.20
BUS 7	.977	7.52	63.75	19.60
BUS 9	1.028	29.25	.00	.00
BUS 11	.974	8.36	87.50	32.20
BUS 13	.954	6.63	42.50	22.40
BUS 14	.971	6.58	17.50	7.00
BUS 16	.972	7.15	31.25	14.00
BUS 17	.994	9.75	13.75	4.20
BUS 20	1.011	3.53	22.50	9.80
BUS 21	.985	2.15	55.00	21.00
BUS 22	.973	4.17	56.25	18.20
BUS 23	.981	16.91	77.50	39.20
BUS 28	.957	9.67	21.25	9.80
BUS 29	.958	7.89	30.00	19.60
BUS 30	.980	16.77	.00	.00
BUS 33	.966	6.84	28.75	12.60
BUS 35	.977	8.35	41.25	26.60
BUS 37	.989	9.58	.00	.00
BUS 38	.956	15.40	.00	.00
BUS 39	.967	7.78	33.75	15.40
BUS 41	.964	7.38	46.25	14.00
BUS 43	.977	7.55	22.50	9.80
BUS 44	.994	8.82	20.00	11.20
BUS 45	1.000	12.14	103.75	63.00
BUS 47	1.014	19.55	80.00	42.00
BUS 48	1.033	18.52	25.00	15.40
BUS 50	1.003	18.66	21.25	5.60
BUS 51	.977	16.31	21.25	11.20
BUS 52	.964	15.20	22.50	7.00
BUS 53	.953	14.13	28.75	15.40
BUS 57	.981	16.32	15.00	4.20
BUS 58	.972	15.58	15.00	4.20
BUS 60	.986	21.96	97.50	60.20
BUS 63	.967	22.21	.00	.00
BUS 64	.982	24.35	.00	.00
BUS 67	1.013	21.62	35.00	9.80
BUS 68	1.001	29.98	.00	.00
BUS 71	.987	23.95	.00	.00
BUS 75	.966	22.12	100.00	35.00
BUS 78	1.000	29.13	88.75	36.40
BUS 79	1.004	29.78	48.75	44.80
BUS 81	.993	31.26	.00	.00
BUS 82	.981	31.74	67.50	37.80
BUS 83	.981	32.70	25.00	14.00
BUS 84	.974	34.75	13.75	9.80
BUS 86	.991	34.21	26.25	14.00
BUS 88	.928	32.72	60.00	35.00
BUS 93	.995	36.06	15.00	9.80
BUS 94	.991	34.93	37.50	22.40
BUS 95	.978	33.85	52.50	43.40
BUS 96	.987	33.00	47.50	21.00
BUS 97	1.007	34.06	18.75	12.60
BUS 98	.974	31.99	80.00	67.20
BUS 101	1.006	37.07	27.50	21.00

BUS 102	1.024	38.91	31.25	4.20
BUS 105	.957	29.95	38.75	47.60
BUS 106	.944	29.35	86.25	50.40
BUS 108	.947	29.09	2.50	1.40
BUS 109	.943	28.78	60.00	14.00
BUS 110	.962	30.63	48.75	35.14
BUS 113	.992	9.54	7.50	-8.96
BUS 114	.954	9.32	25.00	4.20
BUS 115	.953	9.46	43.75	14.00
BUS 117	.955	5.41	25.00	11.20
BUS 118	.959	21.10	41.25	21.00
A 3	1.006	10.13	3.00	1.68
A 4	.996	9.21	9.50	2.24
A 6	.991	8.37	.00	.00
A 7	.981	7.36	28.50	15.26
A 9	1.019	6.20	.00	.00
A 10	1.007	3.82	7.25	2.80
A 12	1.029	4.63	14.00	10.50
A 14	1.007	3.53	7.75	2.24
A 15	1.002	3.40	10.25	3.50
A 16	1.010	3.97	4.38	2.52
A 17	1.001	3.65	11.25	8.12
A 18	.988	2.63	4.00	1.26
A 19	.983	2.43	11.88	4.76
A 20	.988	2.70	2.75	.98
A 21	.991	3.27	21.88	15.68
A 22	.993	3.29	.00	.00
A 23	.989	2.98	4.00	2.24
A 24	.982	2.86	10.88	9.38
A 25	.994	3.42	.00	.00
A 26	.972	2.83	4.38	3.22
A 27	1.013	4.09	.00	.00
A 28	.983	8.49	.00	.00
A 29	.997	3.33	3.00	1.26
A 30	.990	2.98	9.25	3.78
B 3	1.004	1.85	3.00	1.68
B 4	.995	1.51	9.50	2.24
B 6	.990	1.38	.00	.00
B 7	.982	-.90	28.50	15.26
B 9	1.019	-.85	.00	.00
B 10	1.007	-3.26	7.25	2.80
B 12	1.028	-2.75	14.00	10.50
B 14	1.006	-3.80	7.75	2.24
B 15	1.001	-3.88	10.25	3.50
B 16	1.009	-3.28	4.38	2.52
B 17	1.001	-3.48	11.25	8.12
B 18	.987	-4.58	4.00	1.26
B 19	.982	-4.74	11.88	4.76
B 20	.987	-4.44	2.75	.98
B 21	.991	-3.79	21.88	15.68
B 22	.992	-3.75	.00	.00
B 23	.987	-4.15	4.00	2.24
B 24	.980	-4.07	10.88	9.38
B 25	.992	-3.05	.00	.00
B 26	.970	-3.65	4.38	3.22
B 27	1.011	-2.11	.00	.00
B 28	.978	2.69	.00	.00
B 29	.994	-2.87	3.00	1.26
B 30	.987	-3.22	9.25	3.78
C 3	.999	35.64	3.00	1.68

C 4	.988	34.75	9.50	2.24
C 6	.986	33.75	.00	.00
C 7	.974	33.48	28.50	15.26
C 9	1.016	31.50	.00	.00
C 10	1.004	29.07	7.25	2.80
C 12	1.026	29.96	14.00	10.50
C 14	1.004	28.82	7.75	2.24
C 15	.999	28.67	10.25	3.50
C 16	1.007	29.26	4.38	2.52
C 17	.998	28.90	11.25	8.12
C 18	.984	27.89	4.00	1.26
C 19	.980	27.68	11.88	4.76
C 20	.985	27.95	2.75	.98
C 21	.988	28.47	21.88	15.68
C 22	.989	28.49	.00	.00
C 23	.985	28.15	4.00	2.24
C 24	.978	27.90	10.88	9.38
C 25	.989	28.01	.00	.00
C 26	.967	27.41	4.38	3.22
C 27	1.007	28.41	.00	.00
C 28	.980	32.43	.00	.00
C 29	.990	27.64	3.00	1.26
C 30	.983	27.29	9.25	3.78
D 3	.997	17.30	3.00	1.68
D 4	.992	17.25	9.50	2.24
D 6	.996	17.81	.00	.00
D 7	.990	18.66	28.50	15.26
D 9	1.022	15.40	.00	.00
D 10	1.011	12.90	7.25	2.80
D 12	1.028	13.21	14.00	10.50
D 14	1.007	12.17	7.75	2.24
D 15	1.003	12.10	10.25	3.50
D 16	1.012	12.76	4.38	2.52
D 17	1.005	12.65	11.25	8.12
D 18	.989	11.47	4.00	1.26
D 19	.985	11.34	11.88	4.76
D 20	.991	11.66	2.75	.98
D 21	.995	12.33	21.88	15.68
D 22	.996	12.35	.00	.00
D 23	.990	11.80	4.00	2.24
D 24	.985	11.85	10.88	9.38
D 25	.999	12.47	.00	.00
D 26	.978	11.88	4.38	3.22
D 27	1.020	13.18	.00	.00
D 28	.990	17.62	.00	.00
D 29	1.003	12.42	3.00	1.26
D 30	.996	12.08	9.25	3.78
E 4	.960	34.04	59.75	28.00
E 5	.972	37.54	9.50	2.24
E 7	1.005	30.12	.00	.00
E 9	.992	28.08	36.88	23.24
E 10	.988	27.95	11.25	8.12
E 11	1.004	28.53	4.38	2.52
E 12	1.009	28.25	7.63	2.24
E 13	1.001	28.15	16.88	8.12
E 14	.970	26.74	18.63	7.00

Power Generated:	7112.99	3724.52
Power Demanded:	6836.00	3605.14
System Losses:	276.99	119.38

Appendix R

250 Bus Network

Contingency CI

R.1. Bus Oriented Results

Time for input: 2.96
Time for compact: .24
Time for factorization: .30
No. of iterations: 22
Maximum mismatch (in pu): 8.1E-05 7.8E-04
Time for solution: .76
Execution time: 4.25

S base : 100.

Bus	Vsp	Voltage		Generation		QGmin	QGmax	Load	
BUS 69		1.035	30.00	915.06	-74.76				
BUS 1	.960	.947-	-23.28	.00	35.00	-5.00	35.00	66.30	37.80
BUS 4	.998	.998	-16.56	50.00	43.21	-300.00	300.00	39.00	16.80
BUS 6	.990	.981-	-20.07	.00	50.00	-13.00	50.00	67.60	30.80
BUS 8	1.015	1.015	-9.83	40.00	164.44	-300.00	300.00	.00	14.00
BUS 10	1.055	1.055	-.48	285.00	12.28	-147.00	200.00	.00	.00
BUS 12	.990	.976-	-20.44	85.00	120.00	-35.00	120.00	61.10	28.00
BUS 15	.970	.965-	-16.69	.00	50.00	-10.00	50.00	117.00	56.00
BUS 18	.973	.973	-16.31	.00	49.89	-16.00	50.00	78.00	47.60
BUS 19	.960	.966+	-16.82	.00	12.09	-8.00	24.00	58.50	35.00
BUS 24	.992	.992	2.50	49.00	40.07	-300.00	300.00	.00	.00
BUS 25	1.050	1.050	5.00	220.00	92.37	-47.00	140.00	.00	.00
BUS 26	1.015	1.015	7.67	420.00	35.81	-1000.00	1000.00	.00	.00
BUS 27	.968	.968	-9.66	45.00	15.15	-300.00	300.00	26.00	18.20
BUS 31	.967	.967	-14.71	7.00	68.07	-300.00	300.00	55.90	37.80
BUS 32	.963	.963	-12.47	.00	40.98	-14.00	42.00	76.70	32.20
BUS 34	.984	.966-	-6.89	.00	24.00	-8.00	24.00	76.70	36.40
BUS 36	.980	.959-	-7.40	.00	24.00	-8.00	24.00	40.30	23.80
BUS 40	.970	.970	-1.06	80.00	-2.52	-300.00	300.00	26.00	32.20
BUS 42	.985	.985	3.16	90.00	15.30	-300.00	300.00	48.10	32.20
BUS 46	1.080	1.060-	9.21	89.00	100.00	-100.00	100.00	36.40	14.00
BUS 49	1.025	1.025	12.72	300.00	87.60	-85.00	210.00	113.10	42.00
BUS 54	.970	.970	4.98	48.00	48.94	-300.00	300.00	146.90	72.80
BUS 55	.970	.969-	4.54	.00	23.00	-8.00	23.00	81.90	30.80
BUS 56	.970	.972+	5.07	.00	-6.12	-8.00	15.00	109.20	53.20
BUS 59	.985	.985	6.32	.00	158.77	-60.00	180.00	360.10	158.20
BUS 61	.995	.995	13.26	160.00	34.94	-100.00	300.00	.00	.00
BUS 62	.998	.995-	12.24	.00	30.00	-20.00	30.00	100.10	33.60
BUS 65	1.005	1.000-	21.85	500.00	200.00	-67.00	200.00	.00	.00
BUS 66	1.050	1.050	18.97	500.00	39.14	-67.00	200.00	50.70	25.20
BUS 70	.984	.979-	17.33	.00	32.00	-10.00	32.00	85.80	28.00
BUS 72	.980	.980	12.67	43.00	-14.28	-100.00	100.00	.00	.00
BUS 73	.991	.991	18.12	37.00	6.68	-100.00	100.00	.00	.00
BUS 74	.975	.959-	15.75	.00	39.00	-6.00	39.00	88.40	37.80
BUS 76	.970	.967-	15.70	.00	80.00	-8.00	80.00	88.40	51.80
BUS 77	1.006	1.006	23.15	.00	51.09	-20.00	70.00	79.30	28.00
BUS 80	1.040	1.040	25.25	300.00	268.12	-165.00	280.00	169.00	78.40
BUS 85	1.020	1.017-	30.50	.00	22.55	-8.00	23.00	31.20	21.00
BUS 87	1.015	1.015	29.27	4.00	-18.86	-100.00	1000.00	.00	.00
BUS 89	1.055	1.055	40.99	750.00	128.79	-210.00	300.00	.00	.00
BUS 90	.985	.985	37.06	120.00	-22.89	-300.00	300.00	101.40	72.80
BUS 91	.985	.985	37.38	20.00	-42.35	-100.00	100.00	.00	.00
BUS 92	1.030	1.029-	35.53	.00	20.00	-3.00	20.00	84.50	28.00
BUS 99	1.015	1.015	30.59	35.00	-23.93	-100.00	100.00	.00	.00
BUS 100	1.017	1.017	30.97	350.00	96.69	-50.00	155.00	48.10	25.20

BUS 103	1.000	.999-	27.78	40.00	50.00	-15.00	50.00	29.90	22.40
BUS 104	.971	.971	24.58	.00	44.38	-8.00	53.00	49.40	35.00
BUS 107	.980	.980	23.45	45.00	36.39	-200.00	200.00	36.40	16.80
BUS 111	.980	.980	25.76	36.00	12.44	-100.00	1000.00	.00	.00
BUS 112	.975	.975	25.00	55.00	28.46	-100.00	1000.00	32.50	18.20
BUS 116	1.005	1.005	26.17	210.00	95.57	-1000.00	1000.00	.00	.00
A 1	1.050	1.050	6.08	100.00	44.56	-100.00	100.00	.00	.00
A 2	1.045	1.029-	3.43	80.00	80.00	-20.00	80.00	28.21	17.78
A 5	1.010	.986-	-1.86	50.00	62.45	-15.00	62.45	122.46	54.60
A 8	1.000	.987-	-.82	20.00	85.00	-15.00	85.00	39.00	42.00
A 11	1.050	1.050	-.24	20.00	16.98	-10.00	45.83	.00	.00
A 13	1.050	1.050	-2.70	20.00	17.39	-15.00	56.57	.00	.00
B 1	1.050	1.045-	-18.59	100.00	100.00	-100.00	100.00	.00	.00
B 2	1.045	1.034-	-19.80	80.00	60.00	-20.00	60.00	28.21	17.78
B 5	1.010	.989-	-25.57	50.00	62.45	-15.00	62.45	122.46	54.60
B 8	1.010	.983-	-20.27	20.00	75.00	-15.00	75.00	39.00	42.00
B 11	1.050	1.050	-21.22	20.00	18.33	-10.00	45.83	.00	.00
B 13	1.050	1.050	-24.00	20.00	19.53	-15.00	56.57	.00	.00
C 1	1.050	1.050	35.14	100.00	39.33	-100.00	100.00	.00	.00
C 2	1.045	1.044-	33.79	80.00	59.48	-20.00	60.00	28.21	17.78
C 5	1.010	1.010	29.08	50.00	56.14	-15.00	62.45	122.46	54.60
C 8	1.010	1.002-	26.70	20.00	74.37	-15.00	75.00	39.00	42.00
C 11	1.050	1.050	27.37	20.00	14.57	-10.00	45.83	.00	.00
C 13	1.050	1.050	25.13	20.00	15.52	-15.00	56.57	.00	.00
D 1	1.025	1.019-	7.82	100.00	100.00	-100.00	100.00	.00	.00
D 2	1.020	1.020	9.29	80.00	30.67	-20.00	60.00	28.21	17.78
D 5	1.010	1.010	13.03	50.00	39.08	-15.00	62.45	122.46	54.60
D 8	1.010	1.005-	8.89	20.00	75.00	-15.00	75.00	39.00	42.00
D 11	1.050	1.050	7.53	20.00	15.08	-10.00	45.83	.00	.00
D 13	1.050	1.050	4.50	20.00	17.48	-15.00	56.57	.00	.00
E 1	1.060	1.051-	35.38	300.00	90.00	-40.00	90.00	26.00	16.80
E 2	1.045	1.012-	29.93	40.00	50.00	-40.00	50.00	28.21	17.78
E 3	.970	.960-	20.93	.00	70.00	.00	70.00	122.46	54.60
E 6	1.040	1.031-	21.64	.00	34.00	-6.00	34.00	14.56	10.50
E 8	1.050	1.050	22.48	.00	26.51	-6.00	34.00	.00	.00

Bus	Voltage		Load	
BUS 2	.957	-22.04	26.00	12.60
BUS 3	.952	-22.03	65.00	28.00
BUS 5	.998	-16.23	52.00	25.20
BUS 7	.975	-20.69	66.30	19.60
BUS 9	1.039	-5.23	.00	.00
BUS 11	.973	-19.67	91.00	32.20
BUS 13	.951	-20.33	44.20	22.40
BUS 14	.968	-19.99	18.20	7.00
BUS 16	.967	-19.23	32.50	14.00
BUS 17	.989	-13.44	14.30	4.20
BUS 20	1.006	-18.92	23.40	9.80
BUS 21	.978	-20.16	57.20	21.00
BUS 22	.964	-17.64	58.50	18.20
BUS 23	.976	-2.90	80.60	39.20
BUS 28	.957	-12.52	22.10	9.80
BUS 29	.957	-14.52	31.20	19.60
BUS 30	.972	-6.40	.00	.00
BUS 33	.951	-12.77	29.90	12.60
BUS 35	.958	-7.34	42.90	26.60
BUS 37	.970	-5.95	.00	.00
BUS 38	.935	-1.13	.00	.00
BUS 39	.960	-3.58	35.10	15.40
BUS 41	.964	-.91	48.10	14.00
BUS 43	.961	-5.82	23.40	9.80
BUS 44	.984	-.98	20.80	11.20
BUS 45	.992	3.24	107.90	63.00
BUS 47	1.007	12.47	83.20	42.00
BUS 48	1.032	10.33	26.00	15.40
BUS 50	1.002	10.04	22.10	5.60
BUS 51	.975	6.79	22.10	11.20
BUS 52	.962	5.50	23.40	7.00
BUS 53	.952	4.02	29.90	15.40
BUS 57	.980	6.68	15.60	4.20
BUS 58	.970	5.69	15.60	4.20
BUS 60	.986	12.07	101.40	60.20
BUS 63	.961	12.07	.00	.00
BUS 64	.977	15.15	.00	.00
BUS 67	1.011	12.41	36.40	9.80
BUS 68	1.000	25.70	.00	.00
BUS 71	.985	17.17	.00	.00
BUS 75	.959	17.60	104.00	35.00
BUS 78	1.000	22.68	92.30	36.40
BUS 79	1.004	22.89	50.70	44.80
BUS 81	.991	25.56	.00	.00
BUS 82	.990	25.60	70.20	37.80
BUS 83	.997	26.68	26.00	14.00
BUS 84	1.004	28.99	14.30	9.80
BUS 86	1.015	28.80	27.30	14.00
BUS 88	1.016	35.50	62.40	35.00
BUS 93	1.005	32.20	15.60	9.80
BUS 94	.996	29.78	39.00	22.40
BUS 95	.984	28.09	54.60	43.40
BUS 96	.992	26.81	49.40	21.00
BUS 97	1.008	27.14	19.50	12.60
BUS 98	.972	24.70	83.20	67.20
BUS 101	1.011	32.07	28.60	21.00

BUS 102	1.034	34.55	32.50	4.20
BUS 105	.956	23.76	40.30	47.60
BUS 106	.943	23.14	89.70	50.40
BUS 108	.946	22.79	2.60	1.40
BUS 109	.942	22.44	62.40	14.00
BUS 110	.962	24.29	50.70	35.14
BUS 113	.988	-13.49	7.80	-8.96
BUS 114	.954	-12.67	26.00	4.20
BUS 115	.953	-12.54	45.50	14.00
BUS 117	.952	-22.49	26.00	11.20
BUS 118	.954	16.11	42.90	21.00
A 3	1.004	1.48	3.12	1.68
A 4	.993	.58	9.88	2.24
A 6	.988	-.16	.00	.00
A 7	.976	-1.58	29.64	15.26
A 9	1.017	-2.47	.00	.00
A 10	1.005	-4.94	7.54	2.80
A 12	1.027	-4.19	14.56	10.50
A 14	1.005	-5.32	8.06	2.24
A 15	1.000	-5.44	10.66	3.50
A 16	1.008	-4.84	4.55	2.52
A 17	.999	-5.14	11.70	8.12
A 18	.985	-6.23	4.16	1.26
A 19	.980	-6.43	12.35	4.76
A 20	.985	-6.14	2.86	.98
A 21	.989	-5.50	22.75	15.68
A 22	.990	-5.47	.00	.00
A 23	.986	-5.81	4.16	2.24
A 24	.979	-5.84	11.31	9.38
A 25	.992	-4.97	.00	.00
A 26	.970	-5.60	4.55	3.22
A 27	1.012	-4.08	.00	.00
A 28	.981	.76	.00	.00
A 29	.995	-4.89	3.12	1.26
A 30	.988	-5.25	9.62	3.78
B 3	.998	-20.61	3.12	1.68
B 4	.988	-20.94	9.88	2.24
B 6	.984	-21.04	.00	.00
B 7	.974	-23.52	29.64	15.26
B 9	1.014	-23.46	.00	.00
B 10	1.002	-25.99	7.54	2.80
B 12	1.024	-25.50	14.56	10.50
B 14	1.002	-26.60	8.06	2.24
B 15	.997	-26.68	10.66	3.50
B 16	1.005	-26.04	4.55	2.52
B 17	.996	-26.23	11.70	8.12
B 18	.982	-27.41	4.16	1.26
B 19	.977	-27.57	12.35	4.76
B 20	.982	-27.25	2.86	.98
B 21	.985	-26.55	22.75	15.68
B 22	.987	-26.52	.00	.00
B 23	.982	-26.95	4.16	2.24
B 24	.975	-26.84	11.31	9.38
B 25	.986	-25.73	.00	.00
B 26	.964	-26.37	4.55	3.22
B 27	1.005	-24.69	.00	.00
B 28	.972	-19.62	.00	.00
B 29	.988	-25.51	3.12	1.26
B 30	.980	-25.88	9.62	3.78
C 3	1.005	29.72	3.12	1.68

C 4	.995	28.63	9.88	2.24
C 6	.997	27.52	.00	.00
C 7	.990	27.34	29.64	15.26
C 9	1.022	25.15	.00	.00
C 10	1.010	22.67	7.54	2.80
C 12	1.030	23.64	14.56	10.50
C 14	1.008	22.45	8.06	2.24
C 15	1.003	22.29	10.66	3.50
C 16	1.012	22.90	4.55	2.52
C 17	1.004	22.50	11.70	8.12
C 18	.989	21.47	4.16	1.26
C 19	.985	21.24	12.35	4.76
C 20	.990	21.52	2.86	.98
C 21	.994	22.06	22.75	15.68
C 22	.995	22.07	.00	.00
C 23	.990	21.74	4.16	2.24
C 24	.984	21.48	11.31	9.38
C 25	.997	21.62	.00	.00
C 26	.974	20.99	4.55	3.22
C 27	1.017	22.07	.00	.00
C 28	.990	26.24	.00	.00
C 29	1.000	21.27	3.12	1.26
C 30	.992	20.91	9.62	3.78
D 3	.995	7.35	3.12	1.68
D 4	.991	7.35	9.88	2.24
D 6	.995	7.91	.00	.00
D 7	.988	9.07	29.64	15.26
D 9	1.021	5.31	.00	.00
D 10	1.010	2.70	7.54	2.80
D 12	1.027	3.02	14.56	10.50
D 14	1.006	1.92	8.06	2.24
D 15	1.001	1.84	10.66	3.50
D 16	1.010	2.55	4.55	2.52
D 17	1.003	2.43	11.70	8.12
D 18	.987	1.18	4.16	1.26
D 19	.983	1.06	12.35	4.76
D 20	.989	1.39	2.86	.98
D 21	.993	2.09	22.75	15.68
D 22	.994	2.11	.00	.00
D 23	.988	1.51	4.16	2.24
D 24	.983	1.55	11.31	9.38
D 25	.997	2.13	.00	.00
D 26	.974	1.50	4.55	3.22
D 27	1.017	2.83	.00	.00
D 28	.988	7.40	.00	.00
D 29	1.000	2.04	3.12	1.26
D 30	.993	1.68	9.62	3.78
E 4	.961	26.60	62.14	28.00
E 5	.974	29.97	9.88	2.24
E 7	1.006	22.48	.00	.00
E 9	.992	20.33	38.35	23.24
E 10	.988	20.17	11.70	8.12
E 11	1.004	20.74	4.55	2.52
E 12	1.009	20.41	7.93	2.24
E 13	1.001	20.30	17.55	8.12
E 14	.970	18.87	19.37	7.00

Power Generated:	7428.06	3870.41
Power Demanded:	7109.44	3605.14
System Losses:	318.62	265.27

Appendix S

250 Bus Network

Contingency CII

S.1. Bus Oriented Results

```
    Time for input:  2.94
    Time for compact:   .23
    Time for factorization:   .29
No. of iterations: 14
Maximum mismatch (in pu):  9.3E-05 9.8E-04
    Time for solution:   .49
Execution time:  3.95

S base : 100.
```

Bus	Vsp	Voltage		Generation		QGmin	QGmax	Load	
BUS 69		1.035	30.00	136.34	-32.30				
BUS 1	.960	.947-	7.66	.00	35.00	-5.00	35.00	66.30	37.80
BUS 4	.998	.998	15.18	50.00	40.48	-300.00	300.00	39.00	16.80
BUS 6	.990	.981-	11.07	.00	50.00	-13.00	50.00	67.60	30.80
BUS 8	1.015	1.015	23.29	40.00	246.75	-300.00	300.00	.00	14.00
BUS 10	1.055	1.055	42.30	570.00	60.69	-147.00	200.00	.00	.00
BUS 12	.990	.976-	9.96	85.00	120.00	-35.00	120.00	61.10	28.00
BUS 15	.970	.968-	8.57	.00	50.00	-10.00	50.00	117.00	56.00
BUS 18	.973	.973	8.60	.00	47.83	-16.00	50.00	78.00	47.60
BUS 19	.960	.966+	7.26	.00	6.99	-8.00	24.00	58.50	35.00
BUS 24	.992	.992	11.02	49.00	67.19	-300.00	300.00	.00	.00
BUS 25	1.050	1.050	38.40	220.00	35.32	-47.00	140.00	.00	.00
BUS 26	1.015	1.015	39.43	420.00	48.10	-1000.00	1000.00	.00	.00
BUS 27	.968	.968	13.61	45.00	59.41	-300.00	300.00	26.00	18.20
BUS 31	.967	.967	7.95	7.00	70.92	-300.00	300.00	55.90	37.80
BUS 32	.963	.960-	7.97	.00	42.00	-14.00	42.00	76.70	32.20
BUS 34	.984	.982-	13.57	.00	24.00	-8.00	24.00	76.70	36.40
BUS 36	.980	.976-	13.07	.00	24.00	-8.00	24.00	40.30	23.80
BUS 40	.970	.970	16.18	80.00	-27.41	-300.00	300.00	26.00	32.20
BUS 42	.985	.985	18.57	90.00	8.70	-300.00	300.00	48.10	32.20
BUS 46	1.080	1.067-	21.27	89.00	99.35	-100.00	100.00	36.40	14.00
BUS 49	1.025	1.025	24.57	300.00	39.06	-85.00	210.00	113.10	42.00
BUS 54	.970	.970	18.22	48.00	46.40	-300.00	300.00	146.90	72.80
BUS 55	.970	.969-	17.89	.00	23.00	-8.00	23.00	81.90	30.80
BUS 56	.970	.972+	18.34	.00	-7.98	-8.00	15.00	109.20	53.20
BUS 59	.985	.985	21.02	155.00	114.08	-60.00	180.00	360.10	158.20
BUS 61	.995	.995	26.07	160.00	16.78	-100.00	300.00	.00	.00
BUS 62	.998	.995-	24.90	.00	30.00	-20.00	30.00	100.10	33.60
BUS 65	1.005	1.005	32.48	500.00	146.93	-67.00	200.00	.00	.00
BUS 66	1.050	1.050	30.51	500.00	27.96	-67.00	200.00	50.70	25.20
BUS 70	.984	.984	20.98	.00	30.32	-10.00	32.00	85.80	28.00
BUS 72	.980	.980	18.97	43.00	-19.92	-100.00	100.00	.00	.00
BUS 73	.991	.991	22.25	37.00	1.01	-100.00	100.00	.00	.00
BUS 74	.975	.963-	19.70	.00	39.00	-6.00	39.00	88.40	37.80
BUS 76	.970	.967-	21.50	.00	80.00	-8.00	80.00	88.40	51.80
BUS 77	1.006	1.006	31.39	.00	64.08	-20.00	70.00	79.30	28.00
BUS 80	1.040	1.040	36.13	600.00	218.05	-165.00	280.00	169.00	78.40
BUS 85	1.020	1.016-	40.35	.00	23.00	-8.00	23.00	31.20	21.00
BUS 87	1.015	1.015	39.12	4.00	-18.86	-100.00	1000.00	.00	.00
BUS 89	1.055	1.055	51.00	750.00	129.11	-210.00	300.00	.00	.00
BUS 90	.985	.985	47.14	120.00	-23.52	-300.00	300.00	101.40	72.80
BUS 91	.985	.985	47.45	20.00	-42.43	-100.00	100.00	.00	.00
BUS 92	1.030	1.029-	45.60	.00	19.98	-3.00	20.00	84.50	28.00
BUS 99	1.015	1.015	41.05	35.00	-24.29	-100.00	100.00	.00	.00
BUS 100	1.017	1.017	41.25	350.00	95.47	-50.00	155.00	48.10	25.20

BUS 103	1.000	.999-	38.07	40.00	50.00	-15.00	50.00	29.90	22.40
BUS 104	.971	.971	34.86	.00	44.38	-8.00	53.00	49.40	35.00
BUS 107	.980	.980	33.74	45.00	36.39	-200.00	200.00	36.40	16.80
BUS 111	.980	.980	36.05	36.00	12.44	-100.00	1000.00	.00	.00
BUS 112	.975	.975	35.28	55.00	28.46	-100.00	1000.00	32.50	18.20
BUS 116	1.005	1.005	33.98	210.00	86.33	-1000.00	1000.00	.00	.00
A 1	1.050	1.050	20.22	100.00	33.55	-100.00	100.00	.00	.00
A 2	1.045	1.033-	17.82	80.00	79.45	-20.00	80.00	28.21	17.78
A 5	1.010	.994-	13.07	50.00	62.32	-15.00	62.45	122.46	54.60
A 8	1.000	.989-	15.45	20.00	84.87	-15.00	85.00	39.00	42.00
A 11	1.050	1.050	15.24	20.00	16.25	-10.00	45.83	.00	.00
A 13	1.050	1.050	12.63	20.00	16.65	-15.00	56.57	.00	.00
B 1	1.050	1.042-	1.10	100.00	100.00	-100.00	100.00	.00	.00
B 2	1.045	1.030-	-.56	80.00	60.00	-20.00	60.00	28.21	17.78
B 5	1.010	.986-	-6.67	50.00	62.45	-15.00	62.45	122.46	54.60
B 8	1.010	.981-	-2.34	20.00	75.00	-15.00	75.00	39.00	42.00
B 11	1.050	1.050	-2.63	20.00	19.18	-10.00	45.83	.00	.00
B 13	1.050	1.050	-5.34	20.00	20.49	-15.00	56.57	.00	.00
C 1	1.050	1.050	45.12	100.00	39.30	-100.00	100.00	.00	.00
C 2	1.045	1.044-	43.72	80.00	60.00	-20.00	60.00	28.21	17.78
C 5	1.010	1.010	38.93	50.00	56.25	-15.00	62.45	122.46	54.60
C 8	1.010	1.002-	36.42	20.00	75.00	-15.00	75.00	39.00	42.00
C 11	1.050	1.050	37.17	20.00	14.61	-10.00	45.83	.00	.00
C 13	1.050	1.050	34.97	20.00	15.52	-15.00	56.57	.00	.00
D 1	1.025	1.019-	20.88	100.00	99.99	-100.00	100.00	.00	.00
D 2	1.020	1.020	22.12	80.00	29.50	-20.00	60.00	28.21	17.78
D 5	1.010	1.010	25.10	50.00	36.10	-15.00	62.45	122.46	54.60
D 8	1.010	1.006-	21.57	20.00	74.99	-15.00	75.00	39.00	42.00
D 11	1.050	1.050	20.34	20.00	14.89	-10.00	45.83	.00	.00
D 13	1.050	1.050	17.33	20.00	17.28	-15.00	56.57	.00	.00
E 1	1.060	1.052-	45.56	300.00	90.00	-40.00	90.00	26.00	16.80
E 2	1.045	1.013-	40.16	40.00	49.97	-40.00	50.00	28.21	17.78
E 3	.970	.961-	31.15	.00	70.00	.00	70.00	122.46	54.60
E 6	1.040	1.032-	31.80	.00	34.00	-6.00	34.00	14.56	10.50
E 8	1.050	1.050	32.66	.00	26.39	-6.00	34.00	.00	.00

Bus	Voltage		Load	
BUS 2	.958	8.56	26.00	12.60
BUS 3	.953	9.05	65.00	28.00
BUS 5	.998	15.63	52.00	25.20
BUS 7	.975	10.17	66.30	19.60
BUS 9	1.028	32.69	.00	.00
BUS 11	.972	11.04	91.00	32.20
BUS 13	.952	9.13	44.20	22.40
BUS 14	.969	9.06	18.20	7.00
BUS 16	.970	9.68	32.50	14.00
BUS 17	.991	12.28	14.30	4.20
BUS 20	1.003	1.34	23.40	9.80
BUS 21	.975	-1.58	57.20	21.00
BUS 22	.963	-1.24	58.50	18.20
BUS 23	.957	6.89	80.60	39.20
BUS 28	.956	10.51	22.10	9.80
BUS 29	.957	8.24	31.20	19.60
BUS 30	.972	21.12	.00	.00
BUS 33	.963	10.27	29.90	12.60
BUS 35	.974	13.13	42.90	26.60
BUS 37	.987	14.48	.00	.00
BUS 38	.954	19.87	.00	.00
BUS 39	.966	14.83	35.10	15.40
BUS 41	.964	15.85	48.10	14.00
BUS 43	.976	12.40	23.40	9.80
BUS 44	.993	13.92	20.80	11.20
BUS 45	1.000	16.93	107.90	63.00
BUS 47	1.015	22.87	83.20	42.00
BUS 48	1.034	22.66	26.00	15.40
BUS 50	1.003	22.23	22.10	5.60
BUS 51	.976	19.46	22.10	11.20
BUS 52	.963	18.27	23.40	7.00
BUS 53	.953	17.06	29.90	15.40
BUS 57	.980	19.50	15.60	4.20
BUS 58	.971	18.62	15.60	4.20
BUS 60	.986	24.98	101.40	60.20
BUS 63	.966	25.28	.00	.00
BUS 64	.981	27.53	.00	.00
BUS 67	1.012	24.71	36.40	9.80
BUS 68	1.001	33.51	.00	.00
BUS 71	.987	21.28	.00	.00
BUS 75	.963	21.63	104.00	35.00
BUS 78	1.000	31.24	92.30	36.40
BUS 79	1.004	32.07	50.70	44.80
BUS 81	.993	34.53	.00	.00
BUS 82	.990	35.15	70.20	37.80
BUS 83	.997	36.34	26.00	14.00
BUS 84	1.004	38.78	14.30	9.80
BUS 86	1.015	38.65	27.30	14.00
BUS 88	1.016	45.44	62.40	35.00
BUS 93	1.005	42.28	15.60	9.80
BUS 94	.996	39.88	39.00	22.40
BUS 95	.984	38.11	54.60	43.40
BUS 96	.992	36.86	49.40	21.00
BUS 97	1.009	37.52	19.50	12.60
BUS 98	.972	35.37	83.20	67.20
BUS 101	1.012	42.28	28.60	21.00

BUS 102	1.034	44.70	32.50	4.20
BUS 105	.956	34.05	40.30	47.60
BUS 106	.943	33.43	89.70	50.40
BUS 108	.946	33.08	2.60	1.40
BUS 109	.942	32.72	62.40	14.00
BUS 110	.962	34.57	50.70	35.14
BUS 113	.989	11.57	7.80	-8.96
BUS 114	.951	8.95	26.00	4.20
BUS 115	.950	9.29	45.50	14.00
BUS 117	.953	7.91	26.00	11.20
BUS 118	.956	20.98	42.90	21.00
A 3	1.006	16.47	3.12	1.68
A 4	.996	15.76	9.88	2.24
A 6	.990	15.38	.00	.00
A 7	.980	13.74	29.64	15.26
A 9	1.019	13.01	.00	.00
A 10	1.007	10.53	7.54	2.80
A 12	1.028	11.14	14.56	10.50
A 14	1.006	10.03	8.06	2.24
A 15	1.001	9.93	10.66	3.50
A 16	1.010	10.55	4.55	2.52
A 17	1.001	10.30	11.70	8.12
A 18	.986	9.18	4.16	1.26
A 19	.982	8.99	12.35	4.76
A 20	.987	9.30	2.86	.98
A 21	.991	9.96	22.75	15.68
A 22	.992	9.99	.00	.00
A 23	.987	9.59	4.16	2.24
A 24	.981	9.62	11.31	9.38
A 25	.994	10.54	.00	.00
A 26	.972	9.91	4.55	3.22
A 27	1.014	11.46	.00	.00
A 28	.983	16.34	.00	.00
A 29	.997	10.66	3.12	1.26
A 30	.990	10.29	9.62	3.78
B 3	.995	-1.69	3.12	1.68
B 4	.985	-2.19	9.88	2.24
B 6	.981	-2.49	.00	.00
B 7	.971	-4.85	29.64	15.26
B 9	1.013	-4.88	.00	.00
B 10	1.000	-7.39	7.54	2.80
B 12	1.023	-6.83	14.56	10.50
B 14	1.001	-7.94	8.06	2.24
B 15	.995	-8.03	10.66	3.50
B 16	1.004	-7.40	4.55	2.52
B 17	.994	-7.62	11.70	8.12
B 18	.980	-8.78	4.16	1.26
B 19	.975	-8.95	12.35	4.76
B 20	.980	-8.64	2.86	.98
B 21	.983	-7.94	22.75	15.68
B 22	.984	-7.91	.00	.00
B 23	.981	-8.31	4.16	2.24
B 24	.973	-8.20	11.31	9.38
B 25	.983	-7.02	.00	.00
B 26	.961	-7.67	4.55	3.22
B 27	1.002	-5.95	.00	.00
B 28	.969	-.81	.00	.00
B 29	.985	-6.77	3.12	1.26
B 30	.977	-7.14	9.62	3.78
C 3	1.005	39.62	3.12	1.68

C 4	.995	38.52	9.88	2.24
C 6	.997	37.30	.00	.00
C 7	.990	37.15	29.64	15.26
C 9	1.022	34.95	.00	.00
C 10	1.010	32.47	7.54	2.80
C 12	1.030	33.49	14.56	10.50
C 14	1.008	32.29	8.06	2.24
C 15	1.003	32.12	10.66	3.50
C 16	1.012	32.72	4.55	2.52
C 17	1.004	32.31	11.70	8.12
C 18	.989	31.29	4.16	1.26
C 19	.984	31.06	12.35	4.76
C 20	.990	31.33	2.86	.98
C 21	.994	31.86	22.75	15.68
C 22	.995	31.87	.00	.00
C 23	.990	31.56	4.16	2.24
C 24	.984	31.26	11.31	9.38
C 25	.996	31.36	.00	.00
C 26	.974	30.73	4.55	3.22
C 27	1.016	31.78	.00	.00
C 28	.990	35.91	.00	.00
C 29	.999	30.98	3.12	1.26
C 30	.992	30.62	9.62	3.78
D 3	.996	20.21	3.12	1.68
D 4	.991	20.16	9.88	2.24
D 6	.995	20.70	.00	.00
D 7	.989	21.59	29.64	15.26
D 9	1.021	18.12	.00	.00
D 10	1.010	15.52	7.54	2.80
D 12	1.027	15.85	14.56	10.50
D 14	1.006	14.76	8.06	2.24
D 15	1.002	14.68	10.66	3.50
D 16	1.010	15.38	4.55	2.52
D 17	1.003	15.26	11.70	8.12
D 18	.988	14.02	4.16	1.26
D 19	.984	13.89	12.35	4.76
D 20	.989	14.22	2.86	.98
D 21	.994	14.93	22.75	15.68
D 22	.995	14.94	.00	.00
D 23	.989	14.37	4.16	2.24
D 24	.983	14.42	11.31	9.38
D 25	.998	15.09	.00	.00
D 26	.975	14.47	4.55	3.22
D 27	1.018	15.85	.00	.00
D 28	.989	20.50	.00	.00
D 29	1.001	15.06	3.12	1.26
D 30	.994	14.70	9.62	3.78
E 4	.961	36.78	62.14	28.00
E 5	.974	40.13	9.88	2.24
E 7	1.006	32.66	.00	.00
E 9	.992	30.51	38.35	23.24
E 10	.988	30.35	11.70	8.12
E 11	1.005	30.91	4.55	2.52
E 12	1.009	30.58	7.93	2.24
E 13	1.001	30.47	17.55	8.12
E 14	.970	29.05	19.37	7.00

Power Generated:	7389.34	3776.27
Power Demanded:	7109.44	3605.14
System Losses:	279.90	171.13

Appendix T

250 Bus Network

Contingency CIII

T.1. Bus Oriented Results

```
    Time for input:  2.94
    Time for compact:   .24
    Time for factorization:   .29
No. of iterations: 15
Maximum mismatch (in pu):  1.9E-04 8.6E-04
    Time for solution:   .54
Execution time:  4.01

S base : 100.
```

Bus	Vsp	Voltage		Generation		QGmin	QGmax	Load	
BUS 69		1.035	30.00	134.29	-32.98				
BUS 1	.960	.948-	5.01	.00	35.00	-5.00	35.00	66.30	37.80
BUS 4	.998	.998	12.40	50.00	38.74	-300.00	300.00	39.00	16.80
BUS 6	.990	.982-	8.39	.00	50.00	-13.00	50.00	67.60	30.80
BUS 8	1.015	1.015	20.27	40.00	228.18	-300.00	300.00	.00	14.00
BUS 10	1.055	1.055	39.29	570.00	60.69	-147.00	200.00	.00	.00
BUS 12	.990	.977-	7.40	85.00	120.00	-35.00	120.00	61.10	28.00
BUS 15	.970	.969-	6.94	.00	50.00	-10.00	50.00	117.00	56.00
BUS 18	.973	.973	7.11	.00	41.66	-16.00	50.00	78.00	47.60
BUS 19	.960	.966+	6.24	.00	-7.98	-8.00	24.00	58.50	35.00
BUS 24	.992	.992	19.64	49.00	15.03	-300.00	300.00	.00	.00
BUS 25	1.050	1.050	26.44	220.00	88.45	-47.00	140.00	.00	.00
BUS 26	1.015	1.015	29.83	420.00	22.42	-1000.00	1000.00	.00	.00
BUS 27	.968	.968	12.09	45.00	14.08	-300.00	300.00	26.00	18.20
BUS 31	.967	.967	7.65	7.00	65.27	-300.00	300.00	55.90	37.80
BUS 32	.963	.963	9.23	.00	31.52	-14.00	42.00	76.70	32.20
BUS 34	.984	.983-	11.79	.00	23.99	-8.00	24.00	76.70	36.40
BUS 36	.980	.977-	11.28	.00	24.00	-8.00	24.00	40.30	23.80
BUS 40	.970	.970	14.77	80.00	-28.60	-300.00	300.00	26.00	32.20
BUS 42	.985	.985	17.36	90.00	9.08	-300.00	300.00	48.10	32.20
BUS 46	1.080	1.067-	20.39	89.00	100.00	-100.00	100.00	36.40	14.00
BUS 49	1.025	1.025	23.76	300.00	41.11	-85.00	210.00	113.10	42.00
BUS 54	.970	.970	17.43	48.00	46.37	-300.00	300.00	146.90	72.80
BUS 55	.970	.969-	17.11	.00	23.00	-8.00	23.00	81.90	30.80
BUS 56	.970	.972+	17.56	.00	-7.99	-8.00	15.00	109.20	53.20
BUS 59	.985	.985	20.25	155.00	114.09	-60.00	180.00	360.10	158.20
BUS 61	.995	.995	25.31	160.00	16.79	-100.00	300.00	.00	.00
BUS 62	.998	.995-	24.13	.00	30.00	-20.00	30.00	100.10	33.60
BUS 65	1.005	1.005	31.73	500.00	149.95	-67.00	200.00	.00	.00
BUS 66	1.050	1.050	29.74	500.00	27.88	-67.00	200.00	50.70	25.20
BUS 70	.984	.984	23.11	.00	20.62	-10.00	32.00	85.80	28.00
BUS 72	.980	.980	24.54	43.00	-23.27	-100.00	100.00	.00	.00
BUS 73	.991	.991	24.95	37.00	.94	-100.00	100.00	.00	.00
BUS 74	.975	.964-	20.87	.00	39.00	-6.00	39.00	88.40	37.80
BUS 76	.970	.969-	21.93	.00	80.00	-8.00	80.00	88.40	51.80
BUS 77	1.006	1.006	31.22	.00	62.90	-20.00	70.00	79.30	28.00
BUS 80	1.040	1.040	35.59	600.00	221.36	-165.00	280.00	169.00	78.40
BUS 85	1.020	1.011-	43.85	.00	23.00	-8.00	23.00	31.20	21.00
BUS 87	1.015	1.015	42.55	4.00	-17.15	-100.00	1000.00	.00	.00
BUS 89	1.055	1.055	58.49	750.00	97.31	-210.00	300.00	.00	.00
BUS 90	.985	.985	50.24	120.00	.37	-300.00	300.00	101.40	72.80
BUS 91	.985	.985	47.30	20.00	-22.18	-100.00	100.00	.00	.00
BUS 92	1.030	1.010-	41.04	.00	20.00	-3.00	20.00	84.50	28.00
BUS 99	1.015	1.015	39.35	35.00	-25.08	-100.00	100.00	.00	.00
BUS 100	1.017	1.017	39.07	350.00	113.27	-50.00	155.00	48.10	25.20

BUS 103	1.000	.999-	35.89	40.00	50.00	-15.00	50.00	29.90	22.40
BUS 104	.971	.971	32.68	.00	44.38	-8.00	53.00	49.40	35.00
BUS 107	.980	.980	31.55	45.00	36.39	-200.00	200.00	36.40	16.80
BUS 111	.980	.980	33.86	36.00	12.44	-100.00	1000.00	.00	.00
BUS 112	.975	.975	33.10	55.00	28.46	-100.00	1000.00	32.50	18.20
BUS 116	1.005	1.005	33.46	210.00	84.05	-1000.00	1000.00	.00	.00
A 1	1.050	1.050	19.15	100.00	33.80	-100.00	100.00	.00	.00
A 2	1.045	1.033-	16.71	80.00	80.00	-20.00	80.00	28.21	17.78
A 5	1.010	.994-	11.91	50.00	62.45	-15.00	62.45	122.46	54.60
A 8	1.000	.989-	14.14	20.00	85.00	-15.00	85.00	39.00	42.00
A 11	1.050	1.050	14.02	20.00	16.27	-10.00	45.83	.00	.00
A 13	1.050	1.050	11.43	20.00	16.66	-15.00	56.57	.00	.00
B 1	1.050	1.046-	3.37	100.00	100.00	-100.00	100.00	.00	.00
B 2	1.045	1.035-	2.04	80.00	60.00	-20.00	60.00	28.21	17.78
B 5	1.010	.991-	-3.79	50.00	62.45	-15.00	62.45	122.46	54.60
B 8	1.010	.986-	1.25	20.00	75.00	-15.00	75.00	39.00	42.00
B 11	1.050	1.050	.45	20.00	17.73	-10.00	45.83	.00	.00
B 13	1.050	1.050	-2.28	20.00	18.79	-15.00	56.57	.00	.00
C 1	1.050	1.050	43.56	100.00	77.93	-100.00	100.00	.00	.00
C 2	1.045	1.040-	44.52	80.00	60.00	-20.00	60.00	28.21	17.78
C 5	1.010	1.007-	41.47	50.00	62.45	-15.00	62.45	122.46	54.60
C 8	1.010	.997-	37.11	20.00	75.00	-15.00	75.00	39.00	42.00
C 11	1.050	1.050	37.49	20.00	15.68	-10.00	45.83	.00	.00
C 13	1.050	1.050	34.98	20.00	16.95	-15.00	56.57	.00	.00
D 1	1.025	1.019-	20.09	100.00	100.00	-100.00	100.00	.00	.00
D 2	1.020	1.020	21.33	80.00	29.50	-20.00	60.00	28.21	17.78
D 5	1.010	1.010	24.32	50.00	36.12	-15.00	62.45	122.46	54.60
D 8	1.010	1.006-	20.79	20.00	75.00	-15.00	75.00	39.00	42.00
D 11	1.050	1.050	19.56	20.00	14.89	-10.00	45.83	.00	.00
D 13	1.050	1.050	16.55	20.00	17.28	-15.00	56.57	.00	.00
E 1	1.060	1.043-	43.87	300.00	90.00	-40.00	90.00	26.00	16.80
E 2	1.045	1.007-	39.41	40.00	50.00	-40.00	50.00	28.21	17.78
E 3	.970	.954-	30.85	.00	70.00	.00	70.00	122.46	54.60
E 6	1.040	1.026-	32.34	.00	34.00	-6.00	34.00	14.56	10.50
E 8	1.050	1.050	32.99	.00	28.64	-6.00	34.00	.00	.00

Bus	Voltage		Load	
BUS 2	.958	5.97	26.00	12.60
BUS 3	.953	6.38	65.00	28.00
BUS 5	.999	12.83	52.00	25.20
BUS 7	.975	7.53	66.30	19.60
BUS 9	1.028	29.67	.00	.00
BUS 11	.973	8.43	91.00	32.20
BUS 13	.953	6.75	44.20	22.40
BUS 14	.970	6.74	1[illegible].20	7.00
BUS 16	.971	7.30	32.50	14.00
BUS 17	.994	10.28	14.30	4.20
BUS 20	1.007	3.19	23.40	9.80
BUS 21	.981	1.55	57.20	21.00
BUS 22	.968	3.56	58.50	18.20
BUS 23	.980	16.74	80.60	39.20
BUS 28	.957	9.47	22.10	9.80
BUS 29	.957	7.75	31.20	19.60
BUS 30	.980	17.66	.00	.00
BUS 33	.964	8.55	29.90	12.60
BUS 35	.976	11.33	42.90	26.60
BUS 37	.988	12.66	.00	.00
BUS 38	.956	17.72	.00	.00
BUS 39	.967	13.27	35.10	15.40
BUS 41	.964	14.50	48.10	14.00
BUS 43	.976	10.87	23.40	9.80
BUS 44	.993	12.76	20.80	11.20
BUS 45	1.000	15.90	107.90	63.00
BUS 47	1.015	22.15	83.20	42.00
BUS 48	1.034	21.79	26.00	15.40
BUS 50	1.003	21.42	22.10	5.60
BUS 51	.976	18.67	22.10	11.20
BUS 52	.963	17.47	23.40	7.00
BUS 53	.953	16.27	29.90	15.40
BUS 57	.980	18.70	15.60	4.20
BUS 58	.971	17.83	15.60	4.20
BUS 60	.986	24.21	101.40	60.20
BUS 63	.966	24.51	.00	.00
BUS 64	.981	26.77	.00	.00
BUS 67	1.012	23.94	36.40	9.80
BUS 68	1.001	33.00	.00	.00
BUS 71	.987	23.97	.00	.00
BUS 75	.964	22.48	104.00	35.00
BUS 78	1.000	31.02	92.30	36.40
BUS 79	1.004	31.77	50.70	44.80
BUS 81	.993	34.01	.00	.00
BUS 82	.986	35.39	70.20	37.80
BUS 83	.991	37.38	26.00	14.00
BUS 84	.997	41.49	14.30	9.80
BUS 86	1.011	42.11	27.30	14.00
BUS 88	1.010	51.33	62.40	35.00
BUS 93	.995	39.03	15.60	9.80
BUS 94	.992	37.83	39.00	22.40
BUS 95	.981	36.99	54.60	43.40
BUS 96	.989	36.08	49.40	21.00
BUS 97	1.006	36.82	19.50	12.60
BUS 98	.973	34.22	83.20	67.20
BUS 101	1.005	39.73	28.60	21.00

BUS 102	1.022	41.86	32.50	4.20
BUS 105	.956	31.86	40.30	47.60
BUS 106	.943	31.24	89.70	50.40
BUS 108	.946	30.89	2.60	1.40
BUS 109	.942	30.54	62.40	14.00
BUS 110	.962	32.39	50.70	35.14
BUS 113	.992	9.97	7.80	-8.96
BUS 114	.954	9.05	26.00	4.20
BUS 115	.953	9.18	45.50	14.00
BUS 117	.953	5.35	26.00	11.20
BUS 118	.958	21.64	42.90	21.00
A 3	1.006	15.31	3.12	1.68
A 4	.996	14.57	9.88	2.24
A 6	.990	14.15	.00	.00
A 7	.980	12.53	29.64	15.26
A 9	1.019	11.79	.00	.00
A 10	1.007	9.31	7.54	2.80
A 12	1.028	9.94	14.56	10.50
A 14	1.006	8.83	8.06	2.24
A 15	1.001	8.72	10.66	3.50
A 16	1.009	9.34	4.55	2.52
A 17	1.001	9.09	11.70	8.12
A 18	.986	7.97	4.16	1.26
A 19	.982	7.78	12.35	4.76
A 20	.987	8.09	2.86	.98
A 21	.990	8.75	22.75	15.68
A 22	.992	8.78	.00	.00
A 23	.987	8.38	4.16	2.24
A 24	.981	8.41	11.31	9.38
A 25	.994	9.33	.00	.00
A 26	.972	8.69	4.55	3.22
A 27	1.014	10.23	.00	.00
A 28	.983	15.11	.00	.00
A 29	.997	9.43	3.12	1.26
A 30	.989	9.07	9.62	3.78
B 3	1.000	1.16	3.12	1.68
B 4	.990	.79	9.88	2.24
B 6	.986	.62	.00	.00
B 7	.976	-1.81	29.64	15.26
B 9	1.016	-1.78	.00	.00
B 10	1.003	-4.30	7.54	2.80
B 12	1.025	-3.77	14.56	10.50
B 14	1.003	-4.88	8.06	2.24
B 15	.998	-4.96	10.66	3.50
B 16	1.006	-4.33	4.55	2.52
B 17	.997	-4.54	11.70	8.12
B 18	.983	-5.70	4.16	1.26
B 19	.978	-5.87	12.35	4.76
B 20	.983	-5.55	2.86	.98
B 21	.987	-4.86	22.75	15.68
B 22	.988	-4.82	.00	.00
B 23	.984	-5.25	4.16	2.24
B 24	.976	-5.15	11.31	9.38
B 25	.988	-4.05	.00	.00
B 26	.965	-4.69	4.55	3.22
B 27	1.007	-3.02	.00	.00
B 28	.974	2.03	.00	.00
B 29	.989	-3.84	3.12	1.26
B 30	.982	-4.21	9.62	3.78
C 3	1.002	39.19	3.12	1.68

C 4	.992	38.34	9.88	2.24
C 6	.993	37.74	.00	.00
C 7	.986	38.37	29.64	15.26
C 9	1.020	35.27	.00	.00
C 10	1.008	32.72	7.54	2.80
C 12	1.028	33.49	14.56	10.50
C 14	1.006	32.33	8.06	2.24
C 15	1.001	32.19	10.66	3.50
C 16	1.010	32.83	4.55	2.52
C 17	1.002	32.52	11.70	8.12
C 18	.987	31.41	4.16	1.26
C 19	.982	31.22	12.35	4.76
C 20	.988	31.52	2.86	.98
C 21	.992	32.10	22.75	15.68
C 22	.993	32.11	.00	.00
C 23	.987	31.68	4.16	2.24
C 24	.981	31.47	11.31	9.38
C 25	.993	31.63	.00	.00
C 26	.971	30.99	4.55	3.22
C 27	1.013	32.08	.00	.00
C 28	.986	36.27	.00	.00
C 29	.996	31.27	3.12	1.26
C 30	.988	30.91	9.62	3.78
D 3	.996	19.42	3.12	1.68
D 4	.991	19.37	9.88	2.24
D 6	.995	19.92	.00	.00
D 7	.989	20.80	29.64	15.26
D 9	1.021	17.34	.00	.00
D 10	1.010	14.74	7.54	2.80
D 12	1.027	15.06	14.56	10.50
D 14	1.006	13.97	8.06	2.24
D 15	1.002	13.90	10.66	3.50
D 16	1.010	14.59	4.55	2.52
D 17	1.003	14.48	11.70	8.12
D 18	.988	13.23	4.16	1.26
D 19	.984	13.11	12.35	4.76
D 20	.989	13.44	2.86	.98
D 21	.994	14.14	22.75	15.68
D 22	.995	14.16	.00	.00
D 23	.989	13.58	4.16	2.24
D 24	.983	13.64	11.31	9.38
D 25	.998	14.31	.00	.00
D 26	.975	13.68	4.55	3.22
D 27	1.018	15.07	.00	.00
D 28	.989	19.72	.00	.00
D 29	1.001	14.28	3.12	1.26
D 30	.994	13.92	9.62	3.78
E 4	.955	37.10	62.14	28.00
E 5	.968	40.88	9.88	2.24
E 7	1.002	32.99	.00	.00
E 9	.987	30.86	38.35	23.24
E 10	.983	30.72	11.70	8.12
E 11	.999	31.36	4.55	2.52
E 12	1.004	31.09	7.93	2.24
E 13	.995	30.97	17.55	8.12
E 14	.965	29.45	19.37	7.00

Power Generated:	7387.29	3718.16
Power Demanded:	7109.44	3605.14
System Losses:	277.85	113.02

Appendix U

250 Bus Network

Contingency CIV

U.I. Bus Oriented Results

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    Time for input:  2.93
    Time for compact:   .23
    Time for factorization:   .28
No. of iterations: 26
Maximum mismatch (in pu):  5.7E-05 8.9E-04
    Time for solution:   .80
Execution time:  4.25

S base : 100.
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Bus	Vsp	Voltage		Generation		QGmin	QGmax	Load	
BUS 69		1.035	30.00	153.54	-36.13				
BUS 1	.960	.948-	4.90	.00	35.00	-5.00	35.00	66.30	37.80
BUS 4	.998	.998	12.29	50.00	38.74	-300.00	300.00	39.00	16.80
BUS 6	.990	.982-	8.28	.00	50.00	-13.00	50.00	67.60	30.80
BUS 8	1.015	1.015	20.17	40.00	228.18	-300.00	300.00	.00	14.00
BUS 10	1.055	1.055	39.18	570.00	60.69	-147.00	200.00	.00	.00
BUS 12	.990	.977-	7.29	85.00	120.00	-35.00	120.00	61.10	28.00
BUS 15	.970	.969-	6.83	.00	50.00	-10.00	50.00	117.00	56.00
BUS 18	.973	.973	7.00	.00	41.65	-16.00	50.00	78.00	47.60
BUS 19	.960	.966+	6.13	.00	-7.98	-8.00	24.00	58.50	35.00
BUS 24	.992	.992	19.53	49.00	15.02	-300.00	300.00	.00	.00
BUS 25	1.050	1.050	26.33	220.00	88.45	-47.00	140.00	.00	.00
BUS 26	1.015	1.015	29.73	420.00	22.42	-1000.00	1000.00	.00	.00
BUS 27	.968	.968	11.98	45.00	14.08	-300.00	300.00	26.00	18.20
BUS 31	.967	.967	7.54	7.00	65.27	-300.00	300.00	55.90	37.80
BUS 32	.963	.963	9.12	.00	31.51	-14.00	42.00	76.70	32.20
BUS 34	.984	.983-	11.68	.00	24.00	-8.00	24.00	76.70	36.40
BUS 36	.980	.977-	11.18	.00	24.00	-8.00	24.00	40.30	23.80
BUS 40	.970	.970	14.67	80.00	-28.59	-300.00	300.00	26.00	32.20
BUS 42	.985	.985	17.26	90.00	9.09	-300.00	300.00	48.10	32.20
BUS 46	1.080	1.067-	20.30	89.00	100.00	-100.00	100.00	36.40	14.00
BUS 49	1.025	1.025	23.67	300.00	41.25	-85.00	210.00	113.10	42.00
BUS 54	.970	.970	17.33	48.00	46.38	-300.00	300.00	146.90	72.80
BUS 55	.970	.969-	17.01	.00	23.00	-8.00	23.00	81.90	30.80
BUS 56	.970	.972+	17.46	.00	-7.99	-8.00	15.00	109.20	53.20
BUS 59	.985	.985	20.14	155.00	114.08	-60.00	180.00	360.10	158.20
BUS 61	.995	.995	25.20	160.00	16.79	-100.00	300.00	.00	.00
BUS 62	.998	.995-	24.02	.00	30.00	-20.00	30.00	100.10	33.60
BUS 65	1.005	1.005	31.62	500.00	149.64	-67.00	200.00	.00	.00
BUS 66	1.050	1.050	29.63	500.00	27.91	-67.00	200.00	50.70	25.20
BUS 70	.984	.984	23.00	.00	20.94	-10.00	32.00	85.80	28.00
BUS 72	.980	.980	24.43	43.00	-23.27	-100.00	100.00	.00	.00
BUS 73	.991	.991	24.83	37.00	.94	-100.00	100.00	.00	.00
BUS 74	.975	.964-	20.69	.00	39.00	-6.00	39.00	88.40	37.80
BUS 76	.970	.969-	21.63	.00	79.92	-8.00	80.00	88.40	51.80
BUS 77	1.006	1.006-	30.75	.00	70.00	-20.00	70.00	79.30	28.00
BUS 80	1.040	1.040	35.25	600.00	230.53	-165.00	280.00	169.00	78.40
BUS 85	1.020	.971-	39.31	.00	23.00	-8.00	23.00	31.20	21.00
BUS 87	1.015	1.015	37.44	4.00	-4.39	-100.00	1000.00	.00	.00
BUS 89	1.055	1.055	63.30	750.00	106.04	-210.00	300.00	.00	.00
BUS 90	.985	.985	53.11	120.00	18.58	-300.00	300.00	101.40	72.80
BUS 91	.985	.985	49.07	20.00	-15.36	-100.00	100.00	.00	.00
BUS 92	1.030	1.007-	41.29	.00	20.00	-3.00	20.00	84.50	28.00
BUS 99	1.015	1.015	39.08	35.00	-25.04	-100.00	100.00	.00	.00
BUS 100	1.017	1.017	38.83	350.00	124.45	-50.00	155.00	48.10	25.20

BUS 103	1.000	.999-	35.65	40.00	50.00	-15.00	50.00	29.90	22.40
BUS 104	.971	.971	32.44	.00	44.38	-8.00	53.00	49.40	35.00
BUS 107	.980	.980	31.32	45.00	36.39	-200.00	200.00	36.40	16.80
BUS 111	.980	.980	33.62	36.00	12.44	-100.00	1000.00	.00	.00
BUS 112	.975	.975	32.86	55.00	28.46	-100.00	1000.00	32.50	18.20
BUS 116	1.005	1.005	33.34	210.00	83.48	-1000.00	1000.00	.00	.00
A 1	1.050	1.050	19.05	100.00	33.82	-100.00	100.00	.00	.00
A 2	1.045	1.033-	16.62	80.00	80.00	-20.00	80.00	28.21	17.78
A 5	1.010	.994-	11.81	50.00	62.45	-15.00	62.45	122.46	54.60
A 8	1.000	.989-	14.05	20.00	85.00	-15.00	85.00	39.00	42.00
A 11	1.050	1.050	13.93	20.00	16.27	-10.00	45.83	.00	.00
A 13	1.050	1.050	11.33	20.00	16.66	-15.00	56.57	.00	.00
B 1	1.050	1.046-	3.26	100.00	100.00	-100.00	100.00	.00	.00
B 2	1.045	1.035-	1.94	80.00	60.00	-20.00	60.00	28.21	17.78
B 5	1.010	.991-	-3.90	50.00	62.45	-15.00	62.45	122.46	54.60
B 8	1.010	.986-	1.15	20.00	75.00	-15.00	75.00	39.00	42.00
B 11	1.050	1.050	.35	20.00	17.73	-10.00	45.83	.00	.00
B 13	1.050	1.050	-2.39	20.00	18.79	-15.00	56.57	.00	.00
C 1	1.050	1.046-	43.45	100.00	100.00	-100.00	100.00	.00	.00
C 2	1.045	1.026-	44.51	80.00	60.00	-20.00	60.00	28.21	17.78
C 5	1.010	.975-	38.07	50.00	62.45	-15.00	62.45	122.46	54.60
C 8	1.010	.982-	35.40	20.00	75.00	-15.00	75.00	39.00	42.00
C 11	1.050	1.050	36.17	20.00	19.59	-10.00	45.83	.00	.00
C 13	1.050	1.050	33.80	20.00	20.88	-15.00	56.57	.00	.00
D 1	1.025	1.019-	19.99	100.00	99.99	-100.00	100.00	.00	.00
D 2	1.020	1.020	21.23	80.00	29.50	-20.00	60.00	28.21	17.78
D 5	1.010	1.010	24.21	50.00	36.11	-15.00	62.45	122.46	54.60
D 8	1.010	1.006-	20.68	20.00	75.00	-15.00	75.00	39.00	42.00
D 11	1.050	1.050	19.46	20.00	14.89	-10.00	45.83	.00	.00
D 13	1.050	1.050	16.45	20.00	17.28	-15.00	56.57	.00	.00
E 1	1.060	1.039-	44.51	300.00	90.00	-40.00	90.00	26.00	16.80
E 2	1.045	1.003-	40.08	40.00	50.00	-40.00	50.00	28.21	17.78
E 3	.970	.949-	31.78	.00	70.00	.00	70.00	122.46	54.60
E 6	1.040	1.022-	33.80	.00	34.00	-6.00	34.00	14.56	10.50
E 8	1.050	1.050	34.32	.00	30.39	-6.00	34.00	.00	.00

Bus	Voltage		Load	
BUS 2	.958	5.86	26.00	12.60
BUS 3	.953	6.27	65.00	28.00
BUS 5	.999	12.72	52.00	25.20
BUS 7	.975	7.43	66.30	19.60
BUS 9	1.028	29.56	.00	.00
BUS 11	.973	8.32	91.00	32.20
BUS 13	.953	6.64	44.20	22.40
BUS 14	.970	6.63	18.20	7.00
BUS 16	.971	7.19	32.50	14.00
BUS 17	.994	10.17	14.30	4.20
BUS 20	1.007	3.08	23.40	9.80
BUS 21	.981	1.44	57.20	21.00
BUS 22	.968	3.45	58.50	18.20
BUS 23	.980	16.63	80.60	39.20
BUS 28	.957	9.37	22.10	9.80
BUS 29	.957	7.64	31.20	19.60
BUS 30	.980	17.55	.00	.00
BUS 33	.964	8.44	29.90	12.60
BUS 35	.976	11.23	42.90	26.60
BUS 37	.988	12.55	.00	.00
BUS 38	.956	17.61	.00	.00
BUS 39	.967	13.17	35.10	15.40
BUS 41	.964	14.40	48.10	14.00
BUS 43	.976	10.77	23.40	9.80
BUS 44	.993	12.67	20.80	11.20
BUS 45	1.000	15.81	107.90	63.00
BUS 47	1.015	22.07	83.20	42.00
BUS 48	1.034	21.69	26.00	15.40
BUS 50	1.003	21.33	22.10	5.60
BUS 51	.976	18.57	22.10	11.20
BUS 52	.963	17.38	23.40	7.00
BUS 53	.953	16.18	29.90	15.40
BUS 57	.980	18.60	15.60	4.20
BUS 58	.971	17.73	15.60	4.20
BUS 60	.986	24.11	101.40	60.20
BUS 63	.966	24.41	.00	.00
BUS 64	.981	26.66	.00	.00
BUS 67	1.012	23.83	36.40	9.80
BUS 68	1.001	32.87	.00	.00
BUS 71	.987	23.86	.00	.00
BUS 75	.964	22.30	104.00	35.00
BUS 78	1.000	30.57	92.30	36.40
BUS 79	1.003	31.34	50.70	44.80
BUS 81	.993	33.80	.00	.00
BUS 82	.976	34.03	70.20	37.80
BUS 83	.974	35.23	26.00	14.00
BUS 84	.965	37.68	14.30	9.80
BUS 86	.985	37.20	27.30	14.00
BUS 88	.918	35.65	62.40	35.00
BUS 93	.991	38.96	15.60	9.80
BUS 94	.987	37.49	39.00	22.40
BUS 95	.974	36.38	54.60	43.40
BUS 96	.983	35.41	49.40	21.00
BUS 97	1.001	36.73	19.50	12.60
BUS 98	.973	33.91	83.20	67.20
BUS 101	1.003	39.83	28.60	21.00

BUS 102	1.018	42.26	32.50	4.20
BUS 105	.956	31.63	40.30	47.60
BUS 106	.943	31.01	89.70	50.40
BUS 108	.946	30.66	2.60	1.40
BUS 109	.942	30.30	62.40	14.00
BUS 110	.962	32.15	50.70	35.14
BUS 113	.992	9.87	7.80	-8.96
BUS 114	.954	8.94	26.00	4.20
BUS 115	.953	9.08	45.50	14.00
BUS 117	.953	5.24	26.00	11.20
BUS 118	.957	21.40	42.90	21.00
A 3	1.006	15.21	3.12	1.68
A 4	.996	14.48	9.88	2.24
A 6	.990	14.06	.00	.00
A 7	.980	12.44	29.64	15.26
A 9	1.019	11.70	.00	.00
A 10	1.007	9.21	7.54	2.80
A 12	1.028	9.85	14.56	10.50
A 14	1.006	8.73	8.06	2.24
A 15	1.001	8.63	10.66	3.50
A 16	1.009	9.25	4.55	2.52
A 17	1.001	8.99	11.70	8.12
A 18	.986	7.87	4.16	1.26
A 19	.982	7.69	12.35	4.76
A 20	.987	7.99	2.86	.98
A 21	.990	8.65	22.75	15.68
A 22	.992	8.68	.00	.00
A 23	.987	8.29	4.16	2.24
A 24	.981	8.31	11.31	9.38
A 25	.994	9.23	.00	.00
A 26	.972	8.60	4.55	3.22
A 27	1.014	10.14	.00	.00
A 28	.983	15.01	.00	.00
A 29	.997	9.34	3.12	1.26
A 30	.989	8.97	9.62	3.78
B 3	1.000	1.05	3.12	1.68
B 4	.990	.69	9.88	2.24
B 6	.986	.51	.00	.00
B 7	.976	-1.92	29.64	15.26
B 9	1.016	-1.89	.00	.00
B 10	1.003	-4.40	7.54	2.80
B 12	1.025	-3.88	14.56	10.50
B 14	1.003	-4.98	8.06	2.24
B 15	.998	-5.07	10.66	3.50
B 16	1.006	-4.44	4.55	2.52
B 17	.997	-4.64	11.70	8.12
B 18	.983	-5.80	4.16	1.26
B 19	.978	-5.97	12.35	4.76
B 20	.983	-5.66	2.86	.98
B 21	.987	-4.96	22.75	15.68
B 22	.988	-4.93	.00	.00
B 23	.984	-5.35	4.16	2.24
B 24	.976	-5.26	11.31	9.38
B 25	.988	-4.15	.00	.00
B 26	.965	-4.80	4.55	3.22
B 27	1.007	-3.13	.00	.00
B 28	.974	1.92	.00	.00
B 29	.989	-3.94	3.12	1.26
B 30	.982	-4.31	9.62	3.78
C 3	.993	38.44	3.12	1.68

C 4	.981	37.45	9.88	2.24
C 6	.979	36.38	.00	.00
C 7	.966	36.20	29.64	15.26
C 9	1.012	33.93	.00	.00
C 10	.999	31.39	7.54	2.80
C 12	1.023	32.30	14.56	10.50
C 14	1.000	31.11	8.06	2.24
C 15	.995	30.95	10.66	3.50
C 16	1.003	31.58	4.55	2.52
C 17	.994	31.20	11.70	8.12
C 18	.979	30.13	4.16	1.26
C 19	.974	29.91	12.35	4.76
C 20	.980	30.20	2.86	.98
C 21	.983	30.75	22.75	15.68
C 22	.984	30.76	.00	.00
C 23	.980	30.39	4.16	2.24
C 24	.972	30.13	11.31	9.38
C 25	.982	30.24	.00	.00
C 26	.960	29.59	4.55	3.22
C 27	1.001	30.67	.00	.00
C 28	.974	34.87	.00	.00
C 29	.983	29.84	3.12	1.26
C 30	.976	29.47	9.62	3.78
D 3	.996	19.32	3.12	1.68
D 4	.991	19.27	9.88	2.24
D 6	.995	19.82	.00	.00
D 7	.989	20.70	29.64	15.26
D 9	1.021	17.24	.00	.00
D 10	1.010	14.64	7.54	2.80
D 12	1.027	14.96	14.56	10.50
D 14	1.006	13.87	8.06	2.24
D 15	1.002	13.79	10.66	3.50
D 16	1.010	14.49	4.55	2.52
D 17	1.003	14.37	11.70	8.12
D 18	.988	13.13	4.16	1.26
D 19	.984	13.00	12.35	4.76
D 20	.989	13.34	2.86	.98
D 21	.994	14.04	22.75	15.68
D 22	.995	14.06	.00	.00
D 23	.989	13.48	4.16	2.24
D 24	.983	13.54	11.31	9.38
D 25	.998	14.21	.00	.00
D 26	.975	13.58	4.55	3.22
D 27	1.018	14.97	.00	.00
D 28	.989	19.62	.00	.00
D 29	1.001	14.18	3.12	1.26
D 30	.994	13.81	9.62	3.78
E 4	.951	38.42	62.14	28.00
E 5	.963	42.48	9.88	2.24
E 7	.999	34.32	.00	.00
E 9	.983	32.19	38.35	23.24
E 10	.979	32.07	11.70	8.12
E 11	.995	32.77	4.55	2.52
E 12	.999	32.53	7.93	2.24
E 13	.991	32.40	17.55	8.12
E 14	.960	30.81	19.37	7.00

Power Generated:	7406.54	3820.22
Power Demanded:	7109.44	3605.14
System Losses:	297.10	215.08

Appendix V

250 Bus Network

Base Case C

EPSP = EPSQ = 10^{-2}

V.1. Bus Oriented Results

Time for input: 3.03
Time for compact: .24
Time for factorization: .29
No. of iterations: 20
Maximum mismatch (in pu): 6.9E-04 7.8E-03
Time for solution: .57
Execution time: 4.14

S base : 100.

Bus	Vsp	Voltage		Generation		QGmin	QGmax	Load	
BUS 69		1.035	30.00	115.09	-29.93				
BUS 1	.960	.948-	5.15	.00	35.00	-5.00	35.00	66.30	37.80
BUS 4	.998	.998	12.55	50.00	38.00	-300.00	300.00	39.00	16.80
BUS 6	.990	.982-	8.53	.00	50.00	-13.00	50.00	67.60	30.80
BUS 8	1.015	1.015	20.42	40.00	227.99	-300.00	300.00	.00	14.00
BUS 10	1.055	1.055	39.43	570.00	60.69	-147.00	200.00	.00	.00
BUS 12	.990	.977-	7.54	85.00	120.00	-35.00	120.00	61.10	28.00
BUS 15	.970	.969-	7.08	.00	50.00	-10.00	50.00	117.00	56.00
BUS 18	.973	.973	7.25	.00	41.39	-16.00	50.00	78.00	47.60
BUS 19	.960	.966+	6.38	.00	-7.89	-8.00	24.00	58.50	35.00
BUS 24	.992	.992	19.76	49.00	14.96	-300.00	300.00	.00	.00
BUS 25	1.050	1.050	26.58	220.00	88.42	-47.00	140.00	.00	.00
BUS 26	1.015	1.015	29.97	420.00	22.39	-1000.00	1000.00	.00	.00
BUS 27	.968	.968	12.23	45.00	14.08	-300.00	300.00	26.00	18.20
BUS 31	.967	.967	7.79	7.00	65.23	-300.00	300.00	55.90	37.80
BUS 32	.963	.963	9.37	.00	31.40	-14.00	42.00	76.70	32.20
BUS 34	.984	.983-	11.93	.00	24.00	-8.00	24.00	76.70	36.40
BUS 36	.980	.977-	11.43	.00	24.00	-8.00	24.00	40.30	23.80
BUS 40	.970	.970	14.91	80.00	-28.68	-300.00	300.00	26.00	32.20
BUS 42	.985	.985	17.50	90.00	9.08	-300.00	300.00	48.10	32.20
BUS 46	1.080	1.067-	20.52	89.00	100.00	-100.00	100.00	36.40	14.00
BUS 49	1.025	1.025	23.90	300.00	40.90	-85.00	210.00	113.10	42.00
BUS 54	.970	.970	17.58	48.00	46.35	-300.00	300.00	146.90	72.80
BUS 55	.970	.969-	17.26	.00	23.00	-8.00	23.00	81.90	30.80
BUS 56	.970	.972+	17.71	.00	-8.00	-8.00	15.00	109.20	53.20
BUS 59	.985	.985	20.41	155.00	114.10	-60.00	180.00	360.10	158.20
BUS 61	.995	.995	25.47	160.00	16.81	-100.00	300.00	.00	.00
BUS 62	.998	.995-	24.29	.00	30.00	-20.00	30.00	100.10	33.60
BUS 65	1.005	1.005	31.90	500.00	150.47	-67.00	200.00	.00	.00
BUS 66	1.050	1.050	29.89	500.00	27.83	-67.00	200.00	50.70	25.20
BUS 70	.984	.984	23.20	.00	20.53	-10.00	32.00	85.80	28.00
BUS 72	.980	.980	24.64	43.00	-23.28	-100.00	100.00	.00	.00
BUS 73	.991	.991	25.04	37.00	.95	-100.00	100.00	.00	.00
BUS 74	.975	.964-	20.99	.00	39.00	-6.00	39.00	88.40	37.80
BUS 76	.970	.969-	22.14	.00	80.00	-8.00	80.00	88.40	51.80
BUS 77	1.006	1.006	31.53	.00	59.22	-20.00	70.00	79.30	28.00
BUS 80	1.040	1.040	36.13	600.00	220.39	-165.00	280.00	169.00	78.40
BUS 85	1.020	1.017-	40.40	.00	23.00	-8.00	23.00	31.20	21.00
BUS 87	1.015	1.015	39.17	4.00	-18.86	-100.00	1000.00	.00	.00
BUS 89	1.055	1.055	51.05	750.00	129.03	-210.00	300.00	.00	.00
BUS 90	.985	.985	47.19	120.00	-23.57	-300.00	300.00	101.40	72.80
BUS 91	.985	.985	47.50	20.00	-42.44	-100.00	100.00	.00	.00
BUS 92	1.030	1.029-	45.64	.00	20.00	-3.00	20.00	84.50	28.00
BUS 99	1.015	1.015	41.08	35.00	-24.27	-100.00	100.00	.00	.00
BUS 100	1.017	1.017	41.29	350.00	95.49	-50.00	155.00	48.10	25.20

BUS 103	1.000	.999-	38.10	40.00	50.00	-15.00	50.00	29.90	22.40
BUS 104	.971	.971	34.90	.00	44.38	-8.00	53.00	49.40	35.00
BUS 107	.980	.980	33.77	45.00	36.39	-200.00	200.00	36.40	16.80
BUS 111	.980	.980	36.08	36.00	12.44	-100.00	1000.00	.00	.00
BUS 112	.975	.975	35.32	55.00	28.46	-100.00	1000.00	32.50	18.20
BUS 116	1.005	1.005	33.65	210.00	84.99	-1000.00	1000.00	.00	.00
A 1	1.050	1.050	19.28	100.00	33.77	-100.00	100.00	.00	.00
A 2	1.045	1.033-	16.85	80.00	80.00	-20.00	80.00	28.21	17.78
A 5	1.010	.994-	12.04	50.00	62.45	-15.00	62.45	122.46	54.60
A 8	1.000	.989-	14.28	20.00	85.00	-15.00	85.00	39.00	42.00
A 11	1.050	1.050	14.16	20.00	16.27	-10.00	45.83	.00	.00
A 13	1.050	1.050	11.57	20.00	16.65	-15.00	56.57	.00	.00
B 1	1.050	1.046-	3.51	100.00	100.00	-100.00	100.00	.00	.00
B 2	1.045	1.035-	2.18	80.00	60.00	-20.00	60.00	28.21	17.78
B 5	1.010	.991-	-3.65	50.00	62.45	-15.00	62.45	122.46	54.60
B 8	1.010	.986-	1.39	20.00	75.00	-15.00	75.00	39.00	42.00
B 11	1.050	1.050	.59	20.00	17.68	-10.00	45.83	.00	.00
B 13	1.050	1.050	-2.15	20.00	18.74	-15.00	56.57	.00	.00
C 1	1.050	1.050	45.17	100.00	39.25	-100.00	100.00	.00	.00
C 2	1.045	1.044-	43.77	80.00	60.00	-20.00	60.00	28.21	17.78
C 5	1.010	1.010	38.99	50.00	56.21	-15.00	62.45	122.46	54.60
C 8	1.010	1.002-	36.49	20.00	75.00	-15.00	75.00	39.00	42.00
C 11	1.050	1.050	37.23	20.00	14.61	-10.00	45.83	.00	.00
C 13	1.050	1.050	35.03	20.00	15.51	-15.00	56.57	.00	.00
D 1	1.025	1.019-	20.24	100.00	100.00	-100.00	100.00	.00	.00
D 2	1.020	1.020	21.48	80.00	29.50	-20.00	60.00	28.21	17.78
D 5	1.010	1.010	24.47	50.00	36.12	-15.00	62.45	122.46	54.60
D 8	1.010	1.006-	20.94	20.00	75.00	-15.00	75.00	39.00	42.00
D 11	1.050	1.050	19.72	20.00	14.89	-10.00	45.83	.00	.00
D 13	1.050	1.050	16.70	20.00	17.28	-15.00	56.57	.00	.00
E 1	1.060	1.052-	45.60	300.00	90.00	-40.00	90.00	26.00	16.80
E 2	1.045	1.013-	40.20	40.00	50.00	-40.00	50.00	28.21	17.78
E 3	.970	.961-	31.18	.00	70.00	.00	70.00	122.46	54.60
E 6	1.040	1.032-	31.85	.00	34.00	-6.00	34.00	14.56	10.50
E 8	1.050	1.050	32.70	.00	26.36	-6.00	34.00	.00	.00

Bus	Voltage		Load	
BUS 2	.958	6.11	26.00	12.60
BUS 3	.953	6.52	65.00	28.00
BUS 5	.999	12.97	52.00	25.20
BUS 7	.976	7.67	66.30	19.60
BUS 9	1.028	29.81	.00	.00
BUS 11	.973	8.57	91.00	32.20
BUS 13	.953	6.89	44.20	22.40
BUS 14	.970	6.88	18.20	7.00
BUS 16	.971	7.44	32.50	14.00
BUS 17	.994	10.42	14.30	4.20
BUS 20	1.007	3.33	23.40	9.80
BUS 21	.981	1.69	57.20	21.00
BUS 22	.968	3.69	58.50	18.20
BUS 23	.980	16.87	80.60	39.20
BUS 28	.957	9.61	22.10	9.80
BUS 29	.957	7.88	31.20	19.60
BUS 30	.980	17.80	.00	.00
BUS 33	.964	8.69	29.90	12.60
BUS 35	.976	11.48	42.90	26.60
BUS 37	.988	12.80	.00	.00
BUS 38	.956	17.86	.00	.00
BUS 39	.967	13.41	35.10	15.40
BUS 41	.964	14.64	48.10	14.00
BUS 43	.976	11.01	23.40	9.80
BUS 44	.993	12.90	20.80	11.20
BUS 45	1.000	16.03	107.90	63.00
BUS 47	1.015	22.26	83.20	42.00
BUS 48	1.034	21.92	26.00	15.40
BUS 50	1.003	21.56	22.10	5.60
BUS 51	.976	18.81	22.10	11.20
BUS 52	.963	17.62	23.40	7.00
BUS 53	.953	16.42	29.90	15.40
BUS 57	.980	18.85	15.60	4.20
BUS 58	.971	17.97	15.60	4.20
BUS 60	.986	24.38	101.40	60.20
BUS 63	.966	24.68	.00	.00
BUS 64	.981	26.93	.00	.00
BUS 67	1.012	24.10	36.40	9.80
BUS 68	1.001	33.18	.00	.00
BUS 71	.987	24.06	.00	.00
BUS 75	.964	22.61	104.00	35.00
BUS 78	1.000	31.36	92.30	36.40
BUS 79	1.004	32.16	50.70	44.80
BUS 81	.993	34.33	.00	.00
BUS 82	.990	35.22	70.20	37.80
BUS 83	.997	36.41	26.00	14.00
BUS 84	1.004	38.84	14.30	9.80
BUS 86	1.015	38.71	27.30	14.00
BUS 88	1.016	45.49	62.40	35.00
BUS 93	1.005	42.33	15.60	9.80
BUS 94	.996	39.93	39.00	22.40
BUS 95	.984	38.16	54.60	43.40
BUS 96	.992	36.90	49.40	21.00
BUS 97	1.009	37.55	19.50	12.60
BUS 98	.972	35.38	83.20	67.20
BUS 101	1.012	42.32	28.60	21.00

BUS 102	1.034	44.74	32.50	4.20
BUS 105	.956	34.08	40.30	47.60
BUS 106	.943	33.46	89.70	50.40
BUS 108	.946	33.11	2.60	1.40
BUS 109	.942	32.76	62.40	14.00
BUS 110	.962	34.61	50.70	35.14
BUS 113	.992	10.11	7.80	-8.96
BUS 114	.954	9.18	26.00	4.20
BUS 115	.953	9.32	45.50	14.00
BUS 117	.954	5.49	26.00	11.20
BUS 118	.957	21.81	42.90	21.00
A 3	1.006	15.44	3.12	1.68
A 4	.996	14.71	9.88	2.24
A 6	.990	14.29	.00	.00
A 7	.980	12.67	29.64	15.26
A 9	1.019	11.93	.00	.00
A 10	1.007	9.45	7.54	2.80
A 12	1.028	10.08	14.56	10.50
A 14	1.006	8.96	8.06	2.24
A 15	1.001	8.86	10.66	3.50
A 16	1.009	9.48	4.55	2.52
A 17	1.001	9.23	11.70	8.12
A 18	.986	8.11	4.16	1.26
A 19	.982	7.92	12.35	4.76
A 20	.987	8.23	2.86	.98
A 21	.990	8.88	22.75	15.68
A 22	.992	8.91	.00	.00
A 23	.987	8.52	4.16	2.24.
A 24	.981	8.54	11.31	9.38
A 25	.994	9.46	.00	.00
A 26	.972	8.83	4.55	3.22
A 27	1.014	10.37	.00	.00
A 28	.983	15.25	.00	.00
A 29	.997	9.57	3.12	1.26
A 30	.989	9.21	9.62	3.78
B 3	1.000	1.30	3.12	1.68
B 4	.990	.93	9.88	2.24
B 6	.986	.76	.00	.00
B 7	.976	-1.68	29.64	15.26
B 9	1.016	-1.65	.00	.00
B 10	1.003	-4.16	7.54	2.80
B 12	1.025	-3.64	14.56	10.50
B 14	1.003	-4.74	8.06	2.24
B 15	.998	-4.82	10.66	3.50
B 16	1.006	-4.19	4.55	2.52
B 17	.997	-4.40	11.70	8.12
B 18	.983	-5.56	4.16	1.26
B 19	.978	-5.73	12.35	4.76
B 20	.983	-5.41	2.86	.98
B 21	.987	-4.72	22.75	15.68
B 22	.988	-4.68	.00	.00
B 23	.984	-5.11	4.16	2.24
B 24	.976	-5.01	11.31	9.38
B 25	.988	-3.91	.00	.00
B 26	.965	-4.55	4.55	3.22
B 27	1.007	-2.89	.00	.00
B 28	.974	2.16	.00	.00
B 29	.990	-3.70	3.12	1.26
B 30	.982	-4.07	9.62	3.78
C 3	1.005	39.68	3.12	1.68

C 4	.995	38.58	9.88	2.24
C 6	.997	37.36	.00	.00
C 7	.990	37.21	29.64	15.26
C 9	1.022	35.01	.00	.00
C 10	1.010	32.53	7.54	2.80
C 12	1.030	33.54	14.56	10.50
C 14	1.008	32.35	8.06	2.24
C 15	1.003	32.18	10.66	3.50
C 16	1.012	32.78	4.55	2.52
C 17	1.004	32.37	11.70	8.12
C 18	.989	31.35	4.16	1.26
C 19	.984	31.12	12.35	4.76
C 20	.990	31.39	2.86	.98
C 21	.994	31.92	22.75	15.68
C 22	.995	31.93	.00	.00
C 23	.990	31.61	4.16	2.24
C 24	.984	31.32	11.31	9.38
C 25	.996	31.42	.00	.00
C 26	.974	30.79	4.55	3.22
C 27	1.016	31.84	.00	.00
C 28	.990	35.97	.00	.00
C 29	.999	31.04	3.12	1.26
C 30	.992	30.68	9.62	3.78
D 3	.996	19.57	3.12	1.68
D 4	.991	19.52	9.88	2.24
D 6	.995	20.07	.00	.00
D 7	.989	20.96	29.64	15.26
D 9	1.021	17.49	.00	.00
D 10	1.010	14.89	7.54	2.80
D 12	1.027	15.22	14.56	10.50
D 14	1.006	14.13	8.06	2.24
D 15	1.002	14.05	10.66	3.50
D 16	1.010	14.75	4.55	2.52
D 17	1.003	14.63	11.70	8.12
D 18	.988	13.39	4.16	1.26
D 19	.984	13.26	12.35	4.76
D 20	.989	13.59	2.86	.98
D 21	.994	14.30	22.75	15.68
D 22	.995	14.32	.00	.00
D 23	.989	13.74	4.16	2.24
D 24	.983	13.79	11.31	9.38
D 25	.998	14.47	.00	.00
D 26	.975	13.84	4.55	3.22
D 27	1.018	15.23	.00	.00
D 28	.989	19.88	.00	.00
D 29	1.001	14.43	3.12	1.26
D 30	.994	14.07	9.62	3.78
E 4	.961	36.82	62.14	28.00
E 5	.974	40.17	9.88	2.24
E 7	1.006	32.70	.00	.00
E 9	.992	30.55	38.35	23.24
E 10	.988	30.39	11.70	8.12
E 11	1.005	30.95	4.55	2.52
E 12	1.010	30.62	7.93	2.24
E 13	1.001	30.51	17.55	8.12
E 14	.970	29.09	19.37	7.00

Power Generated: 7368.09 3635.16

Power Demanded:	7109.44	3605.14
System Losses:	258.65	30.02

Printout time: 1.32

Appendix W

Benchmark Program

W.1. Program Bench 1

W.1. Program Bench 2

```
      PROGRAM  BENCH1 (INPUT,OUTPUT)
      DOUBLE PRECISION SOS, SON
      INTEGER  I, START, END
      DATA  START/1/, END/10000/

      PRINT *, ' START IS ',START, ' END IS ',END
      TIME0 = SECOND()
      DO  10  K = 1,20
      SOS = 0.0
      SON = 0.0
      DO  100  I = START,END
      SON = SON+I
100   SOS = SOS+I**2
 10   CONTINUE
      TIME = SECOND()
      PRINT *, ' Time out:', TIME-TIME0
      PRINT *, ' SUM OF NUMBER IS ', SON
      PRINT *, ' SUM OF SQUARES IS ', SOS
      TIME = SECOND()
      PRINT *, ' Time final:', TIME-TIME0
      STOP
      END
```

```
 START IS 1 END IS 10000
 Time out:.9690000000001
 SUM OF NUMBER IS 50005000.
 SUM OF SQUARES IS 3.33383335E+11
 Time final:.971
```

```
      PROGRAM  BENCH2 (INPUT,OUTPUT)
      LOGICAL  FLAGS(8191)
      INTEGER  I,J,K,COUNT,ITER,PRIME

      WRITE(*,100)
100   FORMAT (' 10 ITERATIONS')
      TIME0 = SECOND()
      DO  92  ITER = 1,1
          COUNT = 0
          I = 0
        DO  10  I = 1,100
 10     FLAGS(I) = .TRUE.
        DO  91  I = 1,100
            IF (.NOT. FLAGS(I)) GO TO 91
            PRIME = I+I+1
            PRINT*,' I, PRIME: ',I,PRIME
            COUNT = COUNT+1
            K = I+PRIME
            IF (K .GT. 8191) GO TO 91
        DO  60  J = K,8191,PRIME
 60         FLAGS(J) = .FALSE.
 91     CONTINUE
 92   CONTINUE
      TIME = SECOND()
      PRINT *, ' Time out:', TIME-TIME0
      WRITE (*,300) COUNT
      TIME = SECOND()
      PRINT *, ' Time final:', TIME-TIME0
 300  FORMAT ( 1X,I6,' PRIMES')
       END
```

```
10 ITERATIONS
 I, PRIME: 1 3
 I, PRIME: 2 5
 I, PRIME: 3 7
 I, PRIME: 5 11
 I, PRIME: 6 13
 I, PRIME: 8 17
 I, PRIME: 9 19
 I, PRIME: 11 23
 I, PRIME: 14 29
 I, PRIME: 15 31
 I, PRIME: 18 37
 I, PRIME: 20 41
 I, PRIME: 21 43
 I, PRIME: 23 47
 I, PRIME: 26 53
 I, PRIME: 29 59
 I, PRIME: 30 61
 I, PRIME: 33 67
 I, PRIME: 35 71
 I, PRIME: 36 73
 I, PRIME: 39 79
 I, PRIME: 41 83
 I, PRIME: 44 89
 I, PRIME: 48 97
 I, PRIME: 50 101
 I, PRIME: 51 103
 I, PRIME: 53 107
 I, PRIME: 54 109
 I, PRIME: 56 113
 I, PRIME: 63 127
 I, PRIME: 65 131
 I, PRIME: 68 137
 I, PRIME: 69 139
 I, PRIME: 74 149
 I, PRIME: 75 151
 I, PRIME: 78 157
 I, PRIME: 81 163
 I, PRIME: 83 167
 I, PRIME: 86 173
 I, PRIME: 89 179
 I, PRIME: 90 181
 I, PRIME: 95 191
 I, PRIME: 96 193
 I, PRIME: 98 197
 I, PRIME: 99 199
 Time out:.018
    45 PRIMES
 Time final:.019
```

```
      PROGRAM  BENCH2 (INPUT,OUTPUT)
      LOGICAL  FLAGS(8191)
      INTEGER  I,J,K,COUNT,ITER,PRIME

      WRITE(*,100)
100   FORMAT (' 10 ITERATIONS')
      TIME0 = SECOND()
      DO  92  ITER = 1,10
          COUNT = 0
          I = 0
        DO  10  I = 1,8191
 10     FLAGS(I) = .TRUE.
        DO  91  I = 1,8191
            IF (.NOT. FLAGS(I)) GO TO 91
            PRIME = I+I+1
            COUNT = COUNT+1
            K = I+PRIME
            IF (K .GT. 8191) GO TO 91
        DO  60  J = K,8191,PRIME
 60         FLAGS(J) = .FALSE.
 91     CONTINUE
 92   CONTINUE
      TIME = SECOND()
      PRINT *, ' Time out:', TIME-TIME0
      WRITE (*,300) COUNT
      TIME = SECOND()
      PRINT *, ' Time final:', TIME-TIME0
 300  FORMAT ( 1X,I6,' PRIMES')
       END
```

```
 10 ITERATIONS
  Time out:.339
   1899 PRIMES
  Time final:.339
```